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REPORT TO THE PRESIDENT
ON
GOVERNMENT CONTRACTING FOR RESEARCH AND DEVELOPMENT

PREPARED BY THE

BUREAU OF THE BUDGET

AND REFERRED TO THE

COMMITTEE ON GOVERNMENT OPERATIONS
UNITED STATES SENATE

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LETTER OF TRANSMITTAL FROM THE PRESIDENT OF THE UNITED STATES

The White House,
Washington, April 30, 1962.

Hon. Lyndon B. Johnson,
President of the Senate, Washington, D.C.

Dear Mr. President: I transmit herewith for the information of the Senate a report on "Government Contracting for Research and Development," prepared at my request by the Director of the Bureau of the Budget, with the participation of the Secretary of Defense, the Chairman of the Atomic Energy Commission, the Chairman of the U.S. Civil Service Commission, the Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, and the special assistant to the President for science and technology.

I have approved the report and have transmitted it to the heads of departments and agencies for their guidance and action.

The subjects discussed in the report will, I believe, be of particular interest to several committees of the Congress which are concerned with various aspects of the complex problems resulting from the rapid growth of Federal research and development programs. These include criteria for deciding whether to contract out research and development work, improving policies and practices applying to research and development contracting, avoiding possible conflicts of interest by Government contractors, and improving the Government's ability to carry out research and development work directly.

It is plain that the Government's research and development effort must continue to rely heavily on contracts with non-Federal institutions, in order to combine the scientific and technical talents and facilities of the Nation's colleges and universities, businesses, nonprofit organizations, and other private institutions with the Government's own scientific and technical resources. This report points the way to a number of improvements in the present system for conducting the Government's research and development program—improvements which can and will be undertaken by the executive branch under existing authority.

I wish to call particular attention to the conclusions reached in the report regarding Federal salaries. Those who prepared the report—including the heads of the Government's three largest research and development agencies: the Department of Defense, the Atomic Energy Commission, and the National Aeronautics and Space Administration—have stated in the strongest terms the need to raise Federal salaries, especially in the higher grades, if the Government is to obtain and hold first-class scientists, engineers, and administrators. If we are not able to pay these men salaries reasonably comparable with what they can earn in private employment, we cannot hope to have enough

of them in Government to ensure the effective application of science and technology to the great national problems of defense, atomic energy, space exploration, medical research, development assistance, and many other programs heavily dependent on research and development.

Consequently, I most strongly urge action at this session of the Congress to reform the Federal pay structure in accordance with the principle of comparability, as recommended in my message of February 20, 1962.

Sincerely,

JOHN F. KENNEDY.

LETTER TO THE PRESIDENT OF THE UNITED STATES FROM THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D.C., April 30, 1962.

DEAR MR. PRESIDENT: As requested by your letter of July 31, 1961,[1] we have reviewed the experience of the Government in using contracts with private institutions and enterprises to obtain research and development work needed for public purposes.

The attached report presents our findings and conclusions. Without attempting to summarize the complete report, we include in this letter a few of our most significant conclusions, as follows:

1. Federally financed research and development work has been increasing at a phenomenal rate—from $100 million per year in the late 1930's to over $10 billion per year at present, with the bulk of the increase coming since 1950. Over 80 percent of such work is conducted today through non-Federal institutions rather than through direct Federal operations. The growth and size of this work, and the heavy reliance on non-Federal organizations to carry it out, have had a striking impact on the Nation's universities and its industries, and have given rise to the establishment of new kinds of professional and technical organizations. At present the system for conducting Federal research and development work can best be described as a highly complex partnership among various kinds of public and private agencies, related in large part by contractual arrangements.

While many improvements are needed in the conduct of research and development work, and in the contracting systems used, it is our fundamental conclusion that it is in the national interest for the Government to continue to rely heavily on contracts with non-Federal institutions to accomplish scientific and technical work needed for public purposes. A partnership among public and private agencies is the best way in our society to enlist the Nation's resources and achieve the most rapid progress.

2. The basic purposes to be served by Federal research and development programs are public purposes, considered by the President and the Congress to be of sufficient national importance to warrant the expenditure of public funds. The management and control of such programs must be firmly in the hands of full-time Government officials clearly responsible to the President and the Congress. With programs of the size and complexity now common, this requires that the Government have on its staff exceptionally strong and able executives, scientists, and engineers, fully qualified to weigh the views and advice of technical specialists, to make policy decisions concerning the types of work to be undertaken, when, by whom, and at what cost, to supervise the execution of work undertaken, and to evaluate the results.

Ed. note.—See Annex 1, p. 25, for complete text of letter.

At the present time we consider that one of the most serious obstacles to the recruitment and retention of first-class scientists, administrators, and engineers in the Government service is the serious disparity between governmental and private compensation for comparable work. We cannot stress too strongly the importance of rectifying this situation, through congressional enactment of civilian pay reform legislation as you have recommended.

3. Given proper arrangements to maintain management control in the hands of Government officials, federally financed research and development work can be accomplished through several different means: Direct governmental operations of laboratories and other installations; operation of Government-owned facilities by contractors; grants and contracts with universities; contracts with not-for-profit corporations or with profit corporations. Choices among these means should be made on the basis of relative efficiency and effectiveness in accomplishing the desired work, with due regard to the need to maintain and enlarge the long-term strength of the Nation's scientific resources, both public and private.

In addition, the rapid expansion of the use of Government contracts, in a field where 25 years ago they were relatively rare, has brought to the fore a number of different types of possible conflicts of interests, and these should be avoided in assigning research and development work. Clear-cut standards exist with respect to some of these potential conflict-of-interest situations—as is the case with respect to persons in private life acting as advisers and consultants to Government, which was covered in your memorandum of February 9, 1962. Some other standards are now widely accepted—for example, the undesirability of permitting a firm which holds a contract for technical advisory services to seek a contract to develop or to supply any major item with respect to which the firm has advised the Government. Still other standards are needed, and we recommend that you request the head of each department and agency which does a significant amount of contracting for research and development to develop, in consultation with the Attorney General, clear-cut codes of conduct, to provide standards and criteria to guide the public officials and private persons and organizations engaged in research and development activities.

4. We have identified a number of ways in which the contracting system can and should be improved, including:

Providing more incentives for reducing costs and improving performance;

Improving our ability to evaluate the quality of research and development work;

Giving more attention to feasibility studies and the development of specifications prior to inviting private proposals for major systems development, thus reducing "brochuremanship" with its heavy waste of scarce talent.

We have carefully considered the question whether standards should be applied to salaries and related benefits paid by research and development contractors doing work for the Government. We believe it is desirable to do so in those cases in which the system of letting contracts does not result in cost control through competition. We believe the basic standard to be applied should be essentially the same as the standard you recently recommended to the Congress with

respect to Federal employees—namely, comparability with salaries and related benefits paid to persons doing similar work in the private economy. Insofar as a comparability standard cannot be applied—as would be the case with respect to the very top jobs in an organization, for example—we would make it the personal responsibility of the head of the contracting agency to make sure that reasonable limits are applied.

5. Finally, we consider that in recent years there has been a serious trend toward eroding the competence of the Government's research and development establishments—in part owing to the keen competition for scarce talent which has come from Government contractors. We believe it to be highly important to improve this situation—not by setting artificial or arbitrary limits on Government contractors but by sharply improving the working environment within the Government, in order to attract and hold first-class scientists and technicians. In our jugement, the most important improvements that are needed within Government are:

To insure that governmental research and development establishments are assigned significant and challenging work;

To simplify management controls, eliminate unnecessary echelons of review and supervision, and give to laboratory directors more authority to command resources and make administrative decisions; and

To raise salaries, particularly in the higher grades, in order to provide greater comparability with salaries available in private activities.

Action is underway along the first two lines—some of it begun as the result of our review. Only the Congress can act on the third aspect of the problem, and we strongly hope it will do so promptly.

In preparing this report, we have benefited from comments and suggestions by the Attorney General, the Secretaries of Agriculture, Commerce, Labor, and Health, Education, and Welfare, and the Administrator, Federal Aviation Agency, and they concur in general with our findings and conclusions.

ROBERT S. MCNAMARA,
Secretary of Defense.
JAMES E. WEBB,
Administrator, National Aeronautics and Space Administration.
JOHN W. MACY, JR.,
Chairman, Civil Service Commission.
DR. GLENN T. SEABORG,
Chairman, Atomic Energy Commission.
DR. ALAN T. WATERMAN,
Director, National Science Foundation.
JEROME B. WIESNER,
Special Assistant to the President for Science and Technology.
DAVID E. BELL,
Director, Bureau of the Budget.

FOREWORD

This report has been prepared in response to the President's letter of July 31, 1961, to the Director of the Bureau of the Budget, asking for a review of the use of Government contracts with private institutions and enterprises to obtain scientific and technical work needed for public purposes.

Such contracts have been used extensively since the end of World War II to provide for the operation and management of research and development facilities and programs, for analytical studies and advisory services, and for technical supervision of complex systems, as well as for the conduct of research and development projects.

As the President noted in his letter, there is a consensus that the use of contracts is appropriate in many cases. At the same time, a number of important issues have been raised, including the appropriate extent of reliance on contractors, the comparative salaries paid by contractors and the Government, the effect of extensive contracting on the Government's own research and development capabilities, and the extent to which contracts may have been used to avoid limitations which exist on direct Federal operations.

Accordingly, the President asked that the review focus on—

Criteria that should be used in determining whether to perform a function through a contractor or through direct Federal operations;

Actions needed to increase the Government's ability to review contractor operations and to perform scientific and technical work; and

Policies which should be followed by the Government in obtaining maximum efficiency from contractor operations and in reviewing contractor performance and costs (including standards for salaries, fees, and other items).

The President requested the following officials to participate in the study: The Secretary of Defense, the Chairman of the Atomic Energy Commission, the Chairman of the Civil Service Commission, the Administrator of the National Aeronautics and Space Administration, and the Special Assistant to the President for Science and Technology. The Director of the National Science Foundation was also invited to participate.

In making the review requested by the President, a great deal of material was available from hearings and reports of the Senate and House Committees on Appropriations, Armed Services, Judiciary, and Government Operations, the House Committees on Post Office and Civil Service and on Science and Astronautics, the second Hoover Commission, and various governmental and private studies. In addition, information was obtained:

By questionnaires to which 10 Federal agencies and 71 Government field installations, universities, and contract establishments responded; and

By interviews conducted at 28 Government field installations and non-Federal establishments, and with a number of agency headquarters officials.

These data were obtained and analyzed with respect to major policy implications by an interdepartmental staff group which included representatives of each of the officials whom the President asked to participate in the review.

This report presents a summary analysis and recommendations growing out of this review. It is organized in four parts:

1. Statement of major issues.
2. Considerations in deciding whether to contract out research and development work.
3. Proposals for improving policies and practices applying to research and development contracting.
4. Proposals for improving the Government's ability to carry out research and development work directly.

In addition, there are attached to the report the following annexes intended to present additional supporting information:

1. Letter from the President to the Director of the Budget of July 31, 1961.
2. Summary information concerning respondents to Bureau of the Budget questionnaire and organizations interviewed.
3. Special analysis on Federal research and development programs, reprinted from the Federal budget for fiscal year 1963.
4. Summary information concerning the distribution of national research and development funds, activities, and personnel.
5. Summary of information obtained regarding salaries and related benefits and turnover of personnel.
6. Annotated bibliography on Federal contracting-out of research and development.

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PART 1

STATEMENT OF MAJOR ISSUES

Policy questions relating to Government contracting for research and development [1] must be considered in the perspective of the phenomenal growth, diversity, and change in Federal activities in this field.

FEDERAL RESEARCH AND DEVELOPMENT ACTIVITIES AND THEIR IMPACT

Prior to World War II, the total Federal research and development program is estimated to have cost annually about $100 million. In the fiscal year 1950, total Federal research and development expenditures were about $1.1 billion. In the fiscal year 1963, the total is expected to reach $12.4 billion.

The fundamental reason for this growth in expenditures has been the importance of scientific and technical work to the achievement of major public purposes. Since World War II the national defense effort has rested more and more on the search for new technology. Our military posture has come to depend less on production capacity in being and more on the race for shorter lead times in the development and deployment of new weapons systems and of countermeasures against similar systems in the hands of potential enemies. The Defense Department alone is expected to spend $7.1 billion on research and development in fiscal 1963, and the Atomic Energy Commission another $1.4 billion.

Aside from the national defense, science and technology are of increasing significance to many other Federal programs. The Nation's effort in nonmilitary space exploration—which is virtually entirely a research and development effort—is growing extremely rapidly; the National Aeronautics and Space Administration is expected to spend $2.4 billion in fiscal 1963, and additional sums related to the national space program will be spent by the Department of Commerce and other agencies. Moreover, scientific and technological efforts are of major significance in agriculture, health, natural resources, and many other Federal programs.

The end of this period of rapid growth is not yet in sight. Public purposes will continue to require larger and larger scientific and technological efforts for as far ahead as we can see.

The increase in Federal expenditures for research and development has had an enormous impact on the Nation's scientific and technical resources. It is not too much to say that the major initiative and responsibility for promoting and financing research and development have in many important areas been shifted from private enterprise (including academic as well as business institutions) to the Federal

[1] Note on terminology: The term "research and development" is used in this report in the sense in which it is used in the Federal budget—that is, it means the conduct of activities intended to obtain new knowledge or to apply existing knowledge to new uses. The Department of Defense uses the term "research, development, test, and evaluation," which is a somewhat fuller but more cumbersome term for the same concept. In this report the shorter term is used for convenience. For a summary of all Federal activities of this type, see Annex 3, "Federal Research and Development Programs," reprinted from "The Budget of the U.S. Government for fiscal year 1963."

Government. Prior to World War II, the great bulk of the Nation's research achievements occurred with little support from Federal funds— although there were notable exceptions, such as in the field of agriculture. Today it is estimated by the National Science Foundation that the Federal budget finances about 65 percent of the total national expenditure for research and development. Moreover, the Federal share is rising.

Federal financing, however, does not necessarily imply Federal operation. As the Federal research and development effort has risen, there has been a steady reduction in the proportion conducted through direct Federal operations. Today about 80 percent of Federal expenditures for research and development are made through non-Federal institutions. Furthermore, while a major finding of this report is that the Government's capabilities for direct operations in research and development need to be substantially strengthened, there is no doubt that the Government must continue to rely on the private sector for the major share of the scientific and technical work which it requires.[2]

The effects of the extraordinary increase in Federal expenditures for research and development, and the increasing reliance on the private sector to perform such work, have been very far reaching.

The impact on private industry has been striking. In the past the Government utilized profitmaking industry mainly for production engineering and the manufacture of final products—not for research and development. Industries with which it dealt in securing the bulk of its equipment were primarily the traditional large manufacturers for the civilian economy—such as the automotive, machinery, shipbuilding, steel, and oil industries— which relied on the Government for only a portion, usually a minority, of their sales and revenues. In the current scientific age, the older industries have declined in prominence in the advanced equipment area and newer research and development-oriented industries have come to the fore—such as those dealing in aircraft, rockets, electronics, and atomic energy.

There are significant differences between these newer industries and others. While the older industries were organized along mass-production principles, and used large numbers of production workers, the newer ones show roughly a 1-to-1 ratio between production workers and scientist-engineers. Moreover, the proportion of production workers is steadily declining. Between 1954 and 1959, production workers in the aircraft industry declined 17 percent while engineers and scientists increased 96 percent. Also, while the average ratio of research and development expenditures to sales in all industry is about 3 percent, the advanced weapons industry averages about 20 percent and the aerospace industry averages about 31 percent.

But the most striking difference is the reliance of the newer industries almost entirely on Government sales for their business. In 1958, a reasonably representative year, in an older industry, the automotive industry, military sales ranged from 5 percent for General Motors to 15 percent for Chrysler. In the same year in the aircraft industry, military sales ranged from a low of 67 percent for Beech Aircraft to a high of 99.2 percent for the Martin Co.

[2] Annex 4 provides data, supplied by the National Science Foundation, on the sources of funds for the national research and development effort and on the distribution of work between the various types of performing installations—direct Federal operations, industry, universities, and not-for-profit establishments.

The present situation, therefore, is one in which a large group of economically significant and technologically advanced industries depend for their existence and growth not on the open competitive market of traditional economic theory, but on sales only to the U.S. Government. And, moreover, companies in these industries have the strongest incentives to seek contracts for research and development work which will give them both the know-how and the preferred position to seek later follow-on production contracts.

The rapid increase in Federal research and development expenditures has had striking effects on other institutions in our society apart from private industry.

There has been a major impact on the universities. The Nation has always depended largely on the universities for carrying out fundamental research. As such work has become more important to Government and more expensive, an increasing share—particularly in the physical and life sciences and engineering—has been supported by Federal funds. The total impact on a university can be sizable. Well over half of the research budgets of such universities as Harvard, Brown, Columbia, Massachusetts Institute of Technology, Stanford, California Institute of Technology, University of Illinois, New York University, and Princeton, for illustration, is supported by Federal funds.

New institutional arrangements have been established in many cases, related to but organized separately from the universities, in order to respond to the needs of the Federal Government. Thus, the Lincoln Laboratory of the Massachusetts Institute of Technology was established by contract with the Air Force to supply research and development services and to establish systems concepts for the continental air defense, and similarly the Jet Propulsion Laboratory was established at the California Institute of Technology to conduct research on rocket propulsion for the Department of the Army and later to supply space craft design and systems engineering services to the National Aeronautics and Space Administration. In addition, other research institutions—such as the Stanford Research Institute—which were established to conduct research on contract for private or public customers, now do a major share of their business with the Federal Government.

In addition to altering the traditional patterns of organization of private industry and the universities, the rise in Federal research and development expenditures has resulted in the creation of entirely new kinds of organizations.

One kind of organization is typified by the Rand Corp., established immediately after World War II, to provide operations research and other analytical services by contract to the Air Force. A number of similar organizations have been established since, more or less modeled on Rand, to provide similar services to other governmental agencies.

A second new kind of organization is the private corporation, generally not-for-profit but sometimes profit, created to furnish the Government with "systems engineering and technical direction" and other professional services. The Aerospace Corp., the MITRE Corp., the Systems Development Corp., and the Planning Research Corporation are illustrations.

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A third new organizational arrangement was pioneered by the Office of Scientific Research and Development during World War II and used by the Atomic Energy Commission, which took over the wartime atomic energy laboratories and added others—all consisting of facilities and equipment owned by the Government but operated under contract by private organizations, either industrial companies or universities.

Apart from their impact on the institutions of our society, Federal needs in research and development are placing critical demands on the national pool of scientific and engineering talent. The National Science Foundation points out that the country's supply of scientists and engineers is increasing at the fairly stable rate of 6 percent annually, while the number engaged in research and development activities is growing at about 10 percent each year. Accordingly, the task of developing our manpower resources in sufficient quality and quantity to keep pace with the expanding research and development effort is a matter of great urgency. The competition for scientists and engineers is becoming keener all the time and requires urgent attention to the expansion of education and training, and to the efficient use of the scientific and technical personnel we have now.

QUESTIONS AND ISSUES CONSIDERED IN THIS REPORT

The dynamic character of the Nation's research and development efforts, as summarized in the preceding paragraphs, has given rise to a number of criticisms and points of concern. For example, concern has been expressed that the Government's ability to perform essential management functions has diminished because of an increasing dependence on contractors to determine policies of a technical nature and to exercise the type of management functions which Government itself should perform. Some have criticized the new not-for-profit contractors, performing systems engineering and technical direction work for the Government, on the grounds that they are intruding on traditional functions performed by competitive industry. Some concern has been expressed that universities are undertaking research and development programs of a nature and size which may interfere with their traditional educational functions. The cost-reimbursement type of contracts the Government uses, particularly with respect to research and development work on weapons and space systems, have been criticized as providing insufficient incentives to keep costs down and insure effective performance. Criticism has been leveled against relying so heavily on contractors to perform research and development work as simply a device for circumventing civil service rules and regulations.

Finally, the developments of recent years have inevitably blurred the traditional dividing lines between the public and private sectors of our Nation. A number of profound questions affecting the structure of our society are raised by our inability to apply the classical distinctions between what is public and what is private. For example, should a corporation created to provide services to Government and receiving 100 percent of its financial support from Government be considered a "public" or a "private" agency? In what sense is a business corporation doing nearly 100 percent of its business with the Government engaged in "free enterprise"?

In light of these criticisms and concerns, an appraisal of the experience in using contracts to accomplish the Government's research and development purposes is evidently timely. We have not, however, in the course of the present review attempted to treat the fundamental philosophical issues indicated in the preceding paragraph. We accept as desirable the present high degree of interdependence and collaboration between Government and private institutions. We believe the present intermingling of the public and private sectors is in the national interest because it affords the largest opportunity for initiative and the competition of ideas from all elements of the technical community. Consequently, it is our judgment that the present complex partnership between Government and private institutions should continue.

On these assumptions, the present report is intended to deal with the practical question: What should the Government do to make the partnership work better in the public interest and with maximum effectiveness and economy?

We deal principally with three aspects of this main question.

There is first the question, what aspects of the research and development effort should be contracted out? This question falls into two parts. One part relates to those crucial powers to manage and control governmental activities which must be retained in the hands of public officials directly answerable to the President and Congress. Are we in danger of contracting out such powers to private organizations? If so, what should be done about it?

The other part of this question relates to activities which do not have to be carried out by Government officials, but on which there is an option: they may be accomplished either by direct Government operations or by contract with non-Federal institutions. What are the criteria that should guide this choice? And if a private institution is chosen, what are the criteria for choice as among universities, not-for-profit corporations, profit corporations, or other possible contractors?

The second question we deal with is what standards and criteria should govern contract terms in cases where research and development is contracted out. For example, to what extent is competition effective in insuring efficient performance at low cost, and when—if at all—must special rules be established to control fees, salaries paid, and other elements of contractor cost?

The third question we deal with is how we can maintain strong research and development institutions as direct Government operations. How can we prevent the best of the Government's research scientists, engineers, and administrators from being drained off to private institutions as a result of higher private salaries and superior private working environments, and how can we attract an adequate number of the most talented new college graduates to a career in Government service?

These questions are treated in the sections which follow.

PART 2

CONSIDERATIONS IN DECIDING WHETHER TO CONTRACT OUT RESEARCH AND DEVELOPMENT WORK

Generalizations about criteria for contracting out research and development work must be reached with caution, in view of the wide variety of different circumstances which must be covered.

A great many Government agencies are involved. The Department of Defense, the National Aeronautics and Space Administration, and the Atomic Energy Commission provide the bulk of Federal financing, but a dozen or more agencies also play significant roles.

Most Federal research and development work is closely related to the specific purpose of the agency concerned—to the creation of new weapons systems for the Department of Defense, for example, or the exploration of new types of atomic power reactors for the Atomic Energy Commission. But a significant portion of the research financed by the Federal Government is aimed at more general targets: to enlarge the national supply of highly trained scientists, for example, as is the case with some programs of the National Science Foundation. And even the most "mission oriented" agencies have often found it desirable to make funds available for basic research to advance the fundamental state of knowledge in fields that are relevant to their missions. Both the Department of Defense and the AEC, for example, make substantial funds available for fundamental research, not related to any specific item of equipment or other end product.

A great many different kinds of activity are involved, which have been classified by some under five headings:

(1) Fundamental research.

(2) Supporting research or exploratory development.

(3) Feasibility studies, operations analysis, and technical advice.

(4) Development and engineering of products, processes, or systems.

(5) Test and evaluation activities.

The lines between many of the activities listed are necessarily uncertain. Nevertheless, it is clear that "research and development" is a phrase that covers a considerable number of different kinds of activity.

Finally, there have been distinct historical developments affecting the different Government agencies. Some agencies, for example, have a tradition of relying primarily on direct Government operations of laboratories—others have precisely the opposite tradition of relying primarily on contracting for the operation of such installations.

Against this background of diversity in several dimensions we have asked what criteria should be used in deciding whether or not to contract out any given research and development task? In outline, our judgment on this question runs as follows:

There are certain functions which should under no circumstances be contracted out. The management and control of the Federal research and development effort must be firmly in the hands of full-time Government officials clearly responsible to the President and the Congress.

Subject to this principle, many kinds of arrangements—including both direct Federal operations and the various patterns of contracting now in use—can and should be used to mobilize the talent and facilities needed to carry out the Federal research and development effort. Not all arrangements, however, are equally suitable for all purposes and under all circumstances, and discriminating choices must be made among them by the Government agencies having research and development responsibilities. These choices should be based primarily on two considerations:

(1) Getting the job done effectively and efficiently, with due regard to the long-term strength of the Nation's scientific and technical resources; and

(2) Avoiding assignments of work which would create inherent conflicts of interest.

Each of these judgments is elaborated below:

STRENGTHENING THE ABILITY OF THE GOVERNMENT TO MANAGE AND CONTROL RESEARCH AND DEVELOPMENT PROGRAMS

We regard it as axiomatic that policy decisions respecting the Government's research and development programs—decisions concerning the types of work to be undertaken when, by whom, and at what cost—must be made by full-time Government officials clearly responsible to the President and to the Congress. Furthermore, such officials must be in a position to supervise the execution of work undertaken, and to evaluate the results. These are basic functions of management which cannot be transferred to any contractor if we are to have proper accountability for the performance of public functions and for the use of public funds.

To say this does not imply that detailed administration of each research and development task must be kept in the hands of top public officials. Indeed, quite the contrary is true, and an appropriate delegation of responsibility—either to subordinate public officials or by contract to private persons or organizations—for the detailed administration of research and development work is essential to its efficient execution.

It is not always easy to draw the line distinguishing essential management and control responsibilities which should not be delegated to private contractors (or, indeed, to governmental research organizations such as laboratories) from those which can and should be so assigned. Recognizing this difficulty, it nevertheless seems to be the case that in recent years there have been instances—particularly in the Department of Defense—where we have come dangerously close to permitting contract employees to exercise functions which belong with top Government management officials. Insofar as this has been true, we believe it is being rectified. Government agencies are now keenly aware of this problem and have taken steps to retain functions essential to the performance of their responsibility under the law.

It is not enough, of course, to recognize that governmental managers must retain top management functions and not contract them out. In order to perform those functions effectively, they must be themselves competent to make the required management decisions and, in addition, have access to all necessary technical advice. Three conclusions follow:

First, where management decisions are based substantially on technical judgments, qualified executives, who can properly utilize the advice of technical consultants, from both inside and outside the Government, are needed to perform them. There must be sufficient technical competence within the Government so that outside technical advice does not become de facto technical decisionmaking. In many instances the executives making the decisions can and should have strong scientific backgrounds. In others, it is possible to have nonscientists so long as they are capable of understanding the technical issues involved and have otherwise appropriate administrative experience.

By and large, we believe it is necessary for the agencies concerned to give increased stress to the need to bring into governmental service as administrators men with scientific or engineering understanding, and during the development of Government career executives, to give many of them the opportunity, through appropriate training and experience, to strengthen their appreciation and understanding of scientific and technical matters. Correspondingly, scientists and engineers should be encouraged and guided to obtain, through appropriate training and experience, a broader understanding of management and public policy matters. The average governmental administrator in the years to come will be dealing with issues having larger and larger scientific and technical content, and his training and experience, both before he enters Government service and after he has joined, should reflect this fact.

At the present time, we are strongly persuaded that one of the most serious obstacles to acquiring and maintaining the managerial competence which the Government needs for its research and development programs is the discrepancy between governmental and private compensation for comparable work. This obstacle has been growing increasingly serious in recent years as increases in Federal pay have been concentrated primarily at the lower end of the pay scale—resulting in the anomalous situation that many officials of Government responsible for administering major elements of Federal research and development programs are paid substantially smaller salaries than personnel of universities, of business corporations, or of not-for-profit organizations who carry out subordinate aspects of those research and development programs.[1] We cannot stress too strongly the importance of rectifying this situation, and hope the Congress will take at this session the action which the President has recommended to reform Federal civilian pay scales.

Second, it is necessary for even the best qualified governmental managers to obtain technical advice from specialists. Such technical advice can be obtained from men within the Government or those outside. When it is obtained from persons outside of Government, special problems of potential conflict of interest are raised which were

[1] Annex 5 summarizes information obtained during the present review regarding salaries and related benefits.

dealt with in the President's recent memorandum entitled "Preventing Conflicts of Interest on the Part of Advisers and Consultants to the Government."

We believe it highly important for the Government to be able to turn to technical advice from its own establishment as well as from outside sources. One major source of this technical knowledge is the Government-operated laboratory or research installation and, as is made clear later in this report, we believe major improvements are needed at the present time in the management and staffing of these installations. A strong base of technical knowledge should be continually maintained within the Government service and available for advice to top management.

Third, we need to be particularly sensitive to the cumulative effects of contracting out Government work. A series of actions to contract out important activities, each wholly justified when considered on its own merits, may when taken together begin to erode the Government's ability to manage its research and development programs. There must be a high degree of awareness of this danger on the part of all governmental officials concerned. Particular attention must be given to strengthening the Government's ability to provide effective technical supervision in the letting and carrying out of contracts, and to developing more adequate measures for performance evaluation.

DETERMINING THE ASSIGNMENT OF RESEARCH AND DEVELOPMENT WORK

As indicated above, we consider it necessary and desirable to use a variety of arrangements to obtain the scientific and technical services needed to accomplish public purposes. Such arrangements include: direct governmental operations through laboratories or other installations; operation of Government-owned facilities by contractors; grants and contracts with universities and entities associated with universities; contracts with not-for-profit corporations wholly or largely devoted to performing work for Government; and contracts with private business corporations. We also feel that innovation is still needed in these matters, and each agency should be encouraged to seek new and better arrangements to accomplish its purposes. Choices among available arrangements should be based primarily on two factors:

Relative effectiveness and efficiency, and
Avoidance of conflicts of interest.

Relative effectiveness and efficiency

In selecting recipients, whether public or private, for research and development assignments, the basic rule (apart from the conflict-of-interest problem) should be to assign the job where it can be done most effectively and efficiently, with due regard to the strengthening of institutional resources as well as to the immediate execution of projects. This criterion does not, in our judgment, lead to a conclusion that certain kinds of work should be assigned only to certain kinds of institutions. Too much depends on individual competence, historical evolution, and other special circumstances to permit any such simple rule to hold. However, it seems clear that some types of facilities have natural advantages which should be made use of. Thus:

Direct Federal operations, such as the governmental laboratory, enjoy a close and continuing relationship to the agency they serve which permits maximum responsiveness to the needs of that agency and a maximum sense of sharing the mission of the agency. Such operations accordingly have a natural advantage in conducting research, feasibility studies, developmental and analytical work, user tests, and evaluations which directly support the management functions of the agency. Furthermore, an agency-operated research and development installation may provide a useful source of technical management personnel for its sponsor.

At the present time we consider that the laboratories and other facilities available to Government are operating under certain important handicaps which should be removed if these facilities are to support properly the Federal research and development effort. These matters are discussed at some length in part 4 of this report.

Colleges and universities have a long tradition in basic research. The processes of graduate education and basic research have long been closely associated, and reinforce each other in many ways. This unique intellectual environment has proven to be highly conducive to successful undirected and creative research by highly skilled specialists. Such research is not amenable to management control by adherence to firm schedules, well-defined objectives, or predetermined methods of work. In the colleges and universities graduate education and basic research constitute an effective means of introducing future research workers to their fields in direct association with experienced people in those fields, and in an atmosphere of active research work. Applied research appropriate to the universities is that which broadly advances the state of the art.

University-associated research centers are well suited to basic or applied research for which the facilities are so large and expensive that the research acquires the character of a major program best carried out in an entity apart from the regular academic organization. Research in such centers often benefits from the active participation of university scientists. At the same time the sponsoring university (and sometimes other, cooperating universities) benefits from increased opportunities for research by its faculties and graduate students.

Not-for-profit organizations (other than universities and contractor-operated Government facilities), if strongly led, can provide a degree of independence, both from Government and from the commercial market, which may make them particularly useful as a source of objective analytical advice and technical services. These organizations have on occasion provided an important means for establishing a competent research organization for a particular task more rapidly than could have been possible within the less flexible administrative requirements of the Government.

Contractor-operated Government facilities appear to be effective, in some instances, in securing competent scientific and technical personnel to perform research and development work where very complex and costly facilities are required and the Government desires to maintain control of those facilities. Under such arrangements, it has been possible for the Government to retain most of the controls inherent in direct Federal operations, while at the same time gaining many of the advantages of flexibility with respect to staffing, organization, and management, which are inherent in university and industrial operations.

Operations in the profit sector of the economy have special advantages when large and complex arrays of resources needed for advanced development and preproduction work must be marshaled quickly. If the contracting system is such as to provide appropriate incentives, operations for profit can have advantages in spurring efficiency, reducing costs, and speeding accomplishments. (It is plain that not all operations in this sector have resulted in low costs or rapid and efficient performance; we regard this as a major problem for the contracting system and discuss it further in pt. 3 of this report.) Contractors in the profit sector may have the advantage of drawing on resources developed to satisfy commercial as well as governmental customers which adds to the flexibility of procurement, and may permit resources to be phased in and out of Government work on demand.

The preceding paragraphs have stressed the advantages of these different types of organization. There are disadvantages relating to each type which must also be taken into account. Universities, for example, are not ordinarily qualified—nor would they wish—to undertake major systems engineering contracts.

We repeat that the advantages—and disadvantages—noted above do not mean that these different types of arrangements should be given areas of monopoly on different kinds of work. There are, by common agreement, considerable advantages derived from the present diversity of operations. It permits great flexibility in establishing and directing different kinds of facilities and units, and in meeting the need for managing different kinds of jobs. Comparison of operations among these various types of organizations helps provide yardsticks for evaluating performance.

Moreover, this diversity helps provide many sources of ideas and of the critical analysis of ideas, on which scientific and technical progress depend. Indeed, we believe that some research (in contrast to development) should be undertaken by most types of organizations. Basic and applied research activities related to the mission of the organization help to provide a better intellectual environment in which to carry out development work. They also assist greatly in recruiting high quality research staff.

In addition to the desirability of making use of the natural areas of advantage within this diversity of arrangements, there is one additional point we would stress. Activities closely related to governmental managerial decisions (such as those in support of contractor selection), or to activities inherently governmental (such as regulatory functions, or technical activities directly bound up with military operations), are likely to call for a direct Federal capability and to be less successfully handled by contract.

Conflicts of interest

There are at least three aspects of the conflict-of-interest problem which arise in connection with governmental research and development work.

First, there are problems relating to private individuals who serve simultaneously as governmental consultants and as officers, directors, or employees of private organizations with which the Government has a contractual relationship. Many of these individuals are among the Nation's most capable people in the research and development field, and can be of very great assistance to Government agencies.

The problems arising in their case with respect to potential conflicts of interest have been dealt with in the President's memorandum of February 9, referred to earlier in this report. The essential standard set out in that memorandum was that no individual serving as an adviser or consultant should render advice on an issue whose outcome would have a direct and predictable effect on the interests of the private organization which he serves. To this end the President asked that arrangements be made whereby each adviser and consultant would disclose the full extent of his private interests, and the responsible Government officials would undertake to make sure that conflict-of-interest situations are avoided.

Second, there is a significant tendency to have on the boards of trustees and directors of the major universities, not-for-profit and profit establishments engaged in Federal research and development work, representatives of other institutions involved in such work. Such interlocking directorships may serve to reinforce and strengthen the overall management of private organizations which are heavily financed by the Government. Certainly it is in the public interest that organizations on whom so much reliance is placed for accomplishing public purposes, should be controlled by the most responsible, mature, and knowledgeable men available in the Nation. However, we see the clear possibility of conflict-of-interest situations developing through such common directorships that might be harmful to the public interest. Members of governing boards of private business enterprises, universities, or other organizations which advise the Government with respect to research and development activities are often simultaneously members of governing boards of organizations which receive or may receive contracts or grants from the Government for research, development, or production work. Unless these board members also serve as consultants to the Government, present conflict-of-interest laws do not apply. The spirit, if not the letter, of the standards of conduct for Government advisers set forth in the President's memorandum, in our judgment, can and should provide guidance to boards and their members with respect to the interrelationships among universities, not-for-profit organizations, and business corporations where Government business is involved. Some boards of trustees and directors have already taken action along these lines.

Beyond this, however, there is a third type of problem which requires consideration: This might be described as potential conflicts of interest relating to organizations rather than to individuals. It arises in several forms—not all of which by any means are yet fully understood. Indeed, in this area of potential conflicts of interest relating to individuals and organizations in the research and development field, we are in an early stage of developing accepted standards for conduct—unlike other fields, such as the law or medicine, where there are long-established standards of conduct.

One form of organizational conflict of interest relates to the distinction between organizations providing professional services (e.g., technical advice) and those providing manufactured products. A conflict of interest could arise, for example, if a private corporation received a contract to provide technical advice and guidance with respect to a weapons system for which that same private corporation later sought a development or production contract, or for which it sought to develop or supply a key sub-system or component. It is

clear that such conflict-of-interest situations can arise whether or not the profit motive is present. The managers of the not-for-profit institutions have necessarily a strong interest in the continuation and success of such institutions, and it is part of good management of Federal research and development programs to avoid placing any contractor—whether profit or nonprofit—in a position where a conflict of interest could clearly exist.

Another kind of issue is raised by the question whether an organization which has been established to provide services to a Government agency should be permitted to seek contracts with other Government agencies—or with non-Government customers. The question has arisen particularly with respect to not-for-profit organizations established to provide professional services.

There is not a clear consensus on this question among Government officials and officers of the organizations in question. We have considered the question far enough to have the following tentative views:

In the case of organizations in the area of operations and policy research (such, for example, as the Rand Corp.), the principal advantages they have to offer are the detached quality and objectivity of their work. Here, too close control by any Government agency may tend to limit objectivity. Organizations of this kind should not be discouraged from dealing with a variety of clients, both in and out of Government.

On the other hand, a number of the organizations which have been established to provide systems engineering and technical direction (such, for example, as Aerospace Corp.) are at least for the time being of value principally as they act as agents of a single client. In time, as programs change and new requirements arise, it may be possible and desirable for such organizations also to achieve a fully independent financial basis, resting on multiple clients, but this would seem more likely to be a later rather than an earlier development.

Enough has been said to indicate that this general area of conflict of interest with respect to research and development work is turning up new kinds of questions and all the answers have not yet been found. We believe it important to continue to work toward setting forth standards of conduct, as was done by the President in his February memorandum. We recommend that the President instruct each department and agency head, in consultation with the Attorney General, to proceed to develop as much of a code of conduct for individuals and organizations in the research and development field as circumstances now permit.

Finally, we would note that beyond any formal standards, we cannot escape the necessity of relying on the sensitive conscience of officials in the Government and in private organizations to make sure that appropriate standards are continually maintained.

PART 3

PROPOSALS FOR IMPROVING POLICIES AND PRACTICES APPLYING TO RESEARCH AND DEVELOPMENT CONTRACTING

During the course of this review, a number of suggestions arose which we believe to indicate desirable improvements in the Government's policies and practices applying to research and development contracting.

IMPROVING THE GOVERNMENT'S COMPETENCE AS A "SOPHISTICATED BUYER"

In order for the contracting system to work effectively, the first requirement is for the Government to be a sophisticated buyer—that is, to know what it wants and how to get it. Mention has already been made of the requirements this placed on governmental management officials. At this point four additional suggestions are made.

1. In the case of many large systems development projects, it has been the practice to invite private corporations to submit proposals to undertake research and development work—relating to a new missile system, for example, or a new aircraft system. Such proposals are often invited before usable and realistic specifications of the system have been worked out in sufficient detail. As a consequence, highly elaborate, independent, and expensive studies are often undertaken by the would-be contractors in the course of submitting their proposals. This is a very costly method of obtaining competitive proposals, and it unnecessarily consumes large amounts of the best creative talent this country possesses, both on the preparation of the proposals and their evaluation. Delivery time pressures may necessitate inviting proposals before specifications are completed, but we believe this practice can and should be substantially curtailed.

This would mean, in many instances, improving the Government's ability to accomplish feasibility studies, or letting special contracts for that purpose, before inviting proposals. In either event, it would require the acceptance of a greater degree of responsibility by Government managers for making preliminary decisions prior to inviting private proposals. We believe the gains from such a change would be substantial in the avoidance of unnecessary and wasteful use of scarce scientific and technical personnel as well as heavy costs to the private contractors concerned—costs which in most cases are passed on to the Government.

2. We believe there is a great deal of work to be done to improve the Government's ability to supervise and to evaluate the conduct of research and development efforts—whether undertaken through public or private facilities. We do not have nearly enough understanding as yet of how to know whether we are getting a good product for our money, whether research and development work is being

competently managed, or how to select the more competent from the less competent as between research and development establishments.

When inadequate technical criteria exist, there is a tendency to substitute conformity with administrative and fiscal procedures for evaluation of substantive performance. What is required is more exchange of information between agencies on their practices in contractor evaluation and on their experience with these practices. A continuing forum should be provided for such exchange. It is possible also that some central and fairly formal means of reporting methods and experience and recording them permanently should be established. We recommend that the Director of the new Office of Science and Technology, when established, be asked to study the possiblity of establishing such a forum and the best means for providing information regarding evaluation practices.

3. With the tremendous proliferation of research and development operations and associated facilities in recent years, it has become difficult for the Government officials who arrange for such work to be done to be aware of all the facilities and manpower that are available. To maintain a complete and continuous roster of manpower, equipment, and organizations, sensitive to month-by-month changes, would undoubtedly be too costly in terms of its value.

Nevertheless, we believe that an organized attempt should be made to improve the current inventory of information on the scientific and technical resources of the country. We recommend that the National Science Foundation consider ways and means of improving the availability of such information for use by all concerned in public and private activities.

4. In addition, the expansion of the Nation's research and development effort has multiplied the difficulties of communication among researchers engaged on related projects at separate facilities, both public and private. It is clear that additional steps should be taken to further efforts to improve the system for the exchange of information in the field of science and technology.

At present a panel on scientific information of the President's Science Advisory Committee is at work on this subject. We expect that its report will be followed by full-scale planning for the establishment of a more effective technical information exchange system, to support the needs of the operating scientist and the engineer.

IMPROVING ARRANGEMENTS WITH THE PRIVATE SECTOR TYPES OF CONTRACTS

The principal type of contract for research and development work which is made with private industry is the cost-plus-fixed-fee contract. Such contracts have been used in this area because of the inherent difficulty of establishing precise objectives for the work to be done and of making costs estimates ahead of time.

At the same time, this type of contract has well-known disadvantages. It provides little or no incentive for private managers to reduce costs or otherwise increase efficiency. Indeed, the cost-plus-fixed-fee contract, in combination with strong pressures from governmental managers to accomplish work on a rapid time schedule, probably provides incentives for raising rather than for reducing costs. If a corporation is judged in terms of whether it accomplishes a result by

a given deadline rather than by whether it accomplishes that result at minimum cost, it will naturally pay less attention to costs and more attention to speed of accomplishment. On the other hand, where there is no given deadline, the cost-plus-fixed-fee contract may serve to prolong the research and development work and induce the contractor to delay completion.

Consequently, we believe it to be desirable to replace cost-plus-fixed-fee contracting with fixed-price contracting wherever that is feasible—as it should be in the procurement of some late-stage development, test work, and services. Where it is judged that cost reimbursement must be retained as the contracting principle, it should be possible in many instances to include an incentive arrangement under which the fee would not be fixed, but would vary according to a predetermined standard which would relate larger fees to lower costs, superior performance, and shorter delivery times. There is ample evidence to prove that if adequate incentives are given by rewards for outstanding performance, both time and money can be saved. Where the nature of the task permits, it may be desirable to include in the contract penalty provisions for inadequate performance.

Finally, if neither fixed-price nor incentive-type contracts are possible, it is still necessary for Government managers to insist on consideration being given to lower cost, as well as better products and shorter delivery times—and to include previous performance as one element in evaluating different contractors and the desirability of awarding them subsequent contracts.

Contract administration

The written contract itself, however well done, is only one aspect of the situation. The administration of a contract requires as much care and effort as the preparation of the contract itself. This is particularly important with respect to changes in system characteristics, for these changes often become the mechanism for justifying cost overruns. Other factors of importance in contract administration are fixing authority and responsibility in both Government and industry, excessive reporting requirements, and an all-too-frequent lack of prearranged milestones for auditing purposes.

Reimbursable costs

Concern has been expressed because of significant differences among the various agencies in policies regarding which costs are eligible for reimbursement—notably with respect to some of the indirect costs. These differences are now being reviewed by the Bureau of the Budget with the cooperation of the Department of Defense, the National Aeronautics and Space Administration, the Atomic Energy Commission, and the General Services Administration.

Arrangements with universities

With respect to universities, Government agencies share responsibility for seeing that research and development financed at universities does not weaken these institutions or distort their functions which are so vital to the national interest.

Government agencies use both grants and contracts in financing research at universities, but in our judgment the grant has proved to be a simpler and more desirable device for Federal financing of fundamental research, where it is in the interest of the Government

not to exercise close control over the objectives and direction of research. Since all relevant Government agencies are now empowered to use grants instead of contracts in supporting basic research, the wider use of this authority should be encouraged.

Apart from this matter, three others seem worthy of comment.

One arises from the extensive use of contracts (or grants) for specific and precisely identified projects. Often there is a tendency to believe that in providing support for a single specific project the chance of finding a solution to a problem is being maximized. In reality, however, less specific support often would permit more effective research in broad areas of science, or in interdisciplinary fields, and provide greater freedom in drawing in more scientists to participate in the work that is undertaken. Universities, too, often find project support cumbersome and awkward. A particular professor may be working on several projects financed by several Government agencies and must make arbitrary decisions in allocating expenses to a particular project. It thus appears both possible and desirable to move in the direction of using grants to support broader programs, or to support the more general activities of an institution, rather than to tie each allocation of funds to a specific project. A number of Government agencies have been moving in this direction and it would be desirable to expand the use of such forms of support as experience warrants.

At the same time, it would not, in our judgment, be appropriate to place major reliance on the institutional grant, since the major purpose of making grants in most cases is to assure that the university personnel and facilities concerned will be devoted to pursuing specific courses of inquiry.

A second problem associated with the support of research at universities is whether the Government should pay all costs, including indirect expenses or "overhead," associated with work financed by the Government. We believe this matter involves two related but distinct questions, which should be separated in considering the appropriate policy to be followed.

1. We believe there is no question that, in those cases in which it is desirable for the Government to pay the entire cost of work done at a university, the Government should pay for allowable indirect as well as direct costs. To do otherwise would be discriminatory against universities in comparison with other kinds of institutions. For purposes of financial and accounting simplicity, in those cases where grants are used, and it is desirable for the Government to pay all allowable costs, it may be possible to work out a uniform or average percentage figure which could be regarded as covering indirect costs.

2. We believe there are many cases in which it is neither necessary nor desirable for the Government to pay all the costs of the work to be done. In many fields of research, a university may gain a great deal from having the research in question done on its campus, with the participation of its faculty and students, and may be able and willing to share in the costs, either through its regular funds or through raising additional funds from foundations, alumni, or by other means. The extent and degree of cost-sharing can and should vary among different agencies and programs, and we are not prepared at this time to suggest any uniform standards—except the negative one that it would be plainly illogical to require that the university uniformly provide its share through the payment of all or a part of the indirect

costs. Only in the exceptional case would this turn out to be the best basis for determining the appropriate sharing of costs.

A third problem relates to the means for furnishing major capital assets for research at universities (such as a major building or a major piece of equipment such as a linear accelerator, synchrotron, or large computer). In most cases, it will be preferable to finance such facilities by a separate grant (or contract), which will insure that careful attention is given to the long-term value of the asset and to the establishment of appropriate arrangements for managing and maintaining it.

Arrangements with respect to not-for-profit organizations other than universities

It has been the practice in contracting for research and development work with such organizations to cover all allowable costs and, in addition, to provide what is commonly called a "fee." The reason for paying a "fee" to not-for-profit organizations is quite different from the reason for paying a fee to profit-making contractors and therefore the term "fee" is misleading. The profitmaking contractor is engaged in business for profit. His profit and the return to his shareholders or investors can only come from the fee. In the case of the not-for-profit organizations, there are no shareholders, but there are two sound reasons to justify payment of a "development" or "general support" allowance to such organizations.

One is that such allowances provide some degree of operational stability and flexibility to organizations which otherwise would be very tightly bound to the precise limitations of cost financing of specific tasks; the allowances can be used to even out variations in the income of the organization resulting from variations in the level of contract work. A second justification is that most not-for-profit organizations must conduct some independent, self-initiated research if they are to obtain and hold highly competent scientists and engineers. Such staff members, it is argued, will only be attracted if they can share, to some extent, in independently directed research efforts.

We consider that both of these arguments have merit and, in consequence, support the continuation of these payments. Both arguments represent incentives to maintain the cohesiveness and the quality of the organization, which is in the interest of the Government. They should underlie the thinking of the Government representatives who negotiate contracts with not-for-profit organizations. But the amount of the "fee" or allowance in each instance must still be determined by bargaining between Government and contractor, in accordance with the independent relationship that is essential to successful contracting.

An important question relating to not-for-profit organizations other than universities, concerns facilities and equipment. In our judgment, the normal rule should be that where facilities and equipment are required to perform research and development work desired by the Government, the Government should either provide the facilities and equipment, or cover their cost as part of the contract. This is the rule relating to profit organizations and would hold in general for not-for-profit organizations—but there are two special problems with respect to the latter.

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First, we believe it is generally not desirable to furnish funds through "fees" for the purpose of enabling a contractor to acquire major capital assets. On the other hand, the Government should not attempt to dictate what a contractor does with his "fee," provided it has been established on a sound and equitable basis, and if a contractor chooses to use part of his "fee" to acquire facilities for use in his self-initiated research, we would see no objection.

Second, we would think it equitable, where the Government has provided facilities, funds to obtain facilities, substantial working capital, or other resources to a contractor, it should, upon dissolution of the organization, be entitled to a first claim upon such resources. This would seem to be a matter which should be governed, insofar as possible, by the terms of the contract—or in the case of any newly established organizations, should be provided in the provisions of its charter.

Salaries and related benefits

In addition to the question of fees and allowances, there has been a great deal of concern over the salaries and related benefits received by persons employed on federally financed research and development work in private institutions, particularly persons employed in not-for-profit establishements doing work exclusively for the Government. Controls have been suggested or urged by congressional committees and others to make sure that there is no excessive expenditure of public funds and to minimize the undesirable competitive effect on the Federal career service.

We agree that where the contracting system does not provide built-in controls (for example, through competitive bidding), attention should be paid to the reasonableness of contractors' salaries and related benefits, and contractors should be reimbursed only for reasonable compensation costs.

The key question is how to decide what is reasonable and appropriate compensation. We believe the basic standard for reimbursement of salaries and related benefits should be one of comparability to compensation of persons doing similar work in the private economy. The President recently proposed to the Congress that the pay for Federal civilian employees should be based on the concept of reasonable comparability with employees doing similar work in the private economy. We believe this to be a sound principle which can be applied in the present circumstances as well.

Application of this comparability principle may require some special compensation surveys (perhaps made by the Bureau of Labor Statistics), which can and should be arranged for as necessary. Furthermore, there will undoubtedly be cases in which comparable data are difficult to obtain—as, for example, with respect to top management jobs. In such cases the specific approval of the head of the Government contracting agency or his designee should be required.

In view of the inherent complexity and sensitivity of this subject, we suggest that special administrative arrangements should be established in each agency. Contract policies respecting salaries and related benefits in each contracting agency should be controlled by an official reporting directly to the head of the agency (in the Department of Defense, to assure uniformity of treatment, by an official reporting directly to the Secretary of Defense), and salaries above a certain level—say $25,000—should require the personal approval of that official.

PART 4

PROPOSALS FOR IMPROVING THE GOVERNMENT'S ABILITY TO CARRY OUT RESEARCH AND DEVELOPMENT ACTIVITIES DIRECTLY

Based on the evidence acquired in the course of this review, we believe there is no doubt that the effects of the substantial increase in contracting out Federal research and development work on the Government's own ability to execute research and development work have been deleterious.

The effects of the sharp rise in contracting out have included the following. First, contractors have often been able to provide a superior working environment for their scientists and engineers—better salaries, better facilities, better administrative support—making contracting operations attractive alternatives to Federal work. Second, it has often seemed that contractors have been given the more significant and more interesting work assignments, leaving Government research and development establishments with routine missions and static programs which do not attract the best talent. Third, additional burdens have often been placed on Government research establishments to assist in evaluating the work of increasing numbers of contractors and to train and educate less skilled contractor personnel—without adding to the total staff and thus detracting from the direct research work which appeals to the most competent personnel. Fourth, scientists in contracting institutions have often had freedom to move "outside of channels" in the Government hierarchy and to participate in program determination and technical advice at the highest levels—freedom frequently not available to the Government's own scientists. Finally, one of the most serious aspects of the contracting out process has been that it has provided an alternative to correcting the deficiencies in the Government's own operations.

In consequence, for some time there has been a serious trend toward the reduction of the competence of Government research and development establishments. Recently a number of significant actions have been started which are intended to reverse this trend. We point particularly to the strong leadership being given within the Defense Department by the Director of Defense Research and Engineering, in striving to raise the capabilities of the Department's laboratories and other research and development facilities.

Nevertheless, we believe the situation is still serious and that major efforts are required.

We consider it a most important objective for the Government to maintain first-class facilities and equipment of its own to carry out research and development work. This observation applies not only to the newer research and development agencies but equally to the older agencies such as Commerce, Interior, and Agriculture.

No matter how heavily the Government relies on private contracting, it should never lose a strong internal competence in research and development. By maintaining such competence it can be sure of

being able to make the difficult but extraordinarily important program decisions which rest on scientific and technical judgments. Moreover, the Government's research facilities are a significant source of management personnel.

Major steps seem to us to be necessary in the following matters:

1. It is generally recognized that having significant and challenging work to do is the most important element in establishing a successful research and development organization. It is suggested that responsibility should be assigned in each department and agency to the Assistant Secretary for Research and Development or his equivalent to make sure that assignments to governmental research facilities are such as to attract and hold first-class men. Furthermore, arrangements should be made to call on Government laboratory and development center personnel to a larger extent for technical advice and participation in broad program and management decisions—in contrast to the predominant use of outside advisers.

2. The evidence is compelling that managerial arrangements for many Government-operated research and development facilities are cumbersome and awkward. Several improvements are needed in many instances, including—

Delegating to research laboratory directors more authority to make program and personnel decisions, to control funds, and otherwise to command the resources which are necessary to carry out the mission of the installation;

Providing the research laboratory director a discretionary allotment of funds, to be available for projects of his choosing, and for the results of which he is to be responsible;

Eliminating where possible excess layers or echelons of supervisory management, and insuring that technical, administrative, and fiscal reviews be conducted concurrently and in coordinated fashion; and

Making laboratory research assignments in the form of a few major items with a reasonable degree of continuity rather than a multiplicity of small narrowly specified tasks; this will put responsibility for detailed definition of the work to be done at the laboratory level where it belongs.

To carry out these improvements will require careful and detailed analysis of the different situations in different agencies. Above all, it will require the energetic direction of top officials in each agency.

Plans have already been developed for joint teams of Civil Service Commission and Department of Defense research and manpower personnel to visit nine defense laboratories during April and May 1962, in order to analyze precisely what administrative restrictions exist that hamper research effectiveness. In this fashion, those unwarranted limitations that can be eliminated by executive action can be identified as distinguished from those that may require legislative change.

3. Salary limitations, as already mentioned, in our opinion play a major role in preventing the Government from obtaining or retaining highly competent men and women. Largely because of the lack of comparable salaries, the Government is not now and has not for at least the past 10 years been able to attract or retain its share of such critically necessary people as: recently graduated, highly recommended Ph. D.'s in mathematics and physics; recent B.S.-M.S. scientific and

engineering graduates in the upper 25 percent of their classes at top-ranked universities; good experienced, weapons systems engineers and missile, space, and electronic specialists at intermediate and senior levels; and senior-level laboratory directors, scientific managers, and administrators. This obstacle will be substantially overcome if the Congress approves the President's recommendation to establish a standard of comparability with private pay levels for higher professional and technical jobs in the Federal service.

4. A special problem in the Defense Department is the relationship between uniformed and civilian personnel. This is a difficult and sensitive problem of which the Department of Defense is well aware. We do not attempt in this report to propose detailed solutions, but we do suggest that certain principles are becoming evident as a result of the experience of recent years.

It seems clear, for example, that the military services will have increasing need for substantial numbers of officers who have extensive scientific and technical training and experience. Such officers bring firsthand knowledge of operational conditions and requirements to research and development installations and, in turn, learn about the state of the art and the feasible applications of technology to military operations. The military officer is needed to communicate the needs of the user, to prepare the operational forces for new equipment, to plan for the use of developing equipment, and later to install it and supervise its use.

All of the above roles suggest that when military personnel are used in research and development activities, they should perform as "technical men" rather than "military men" except when there is a need for their military skills. Military command and direction become important only as one moves from the research end of the spectrum into the area where operational considerations predominate. Both at middle management and policy levels, a well-balanced mixture of military and civilian personnel may be most advantageous in programs designed to meet military needs.

In research, there are many instances in which the existence of military supervision, and the decreased opportunities for advancement because of military occupancy of top jobs, are among the principal reasons why the Defense Department has had difficulty in attracting outstanding civilian scientists and engineers. On the other hand, there are examples within the Department of cases in which enlightened policies of civil-military relationships have drawn on the strengths of each and produced excellent results. In such instances, the military head of the laboratory has usually concentrated on administrative problems and the civilian technical director has had complete control of technical programs.

Military officers should not be substituted for civilians in the direction and management of research and development unless they are technically qualified and their military background is directly needed and applicable.

In the course of the next year, the Department of Defense intends to give consideration to the delineation of those research and development installations in which operational considerations are predominant and those installations in which scientific and technical considerations are predominant. Having done so, the assignment of military officers

to head the former type of installation, and civilians (or equally qualified military officers) to head the latter will be encouraged. Furthermore, when military personnel are assigned to work in civilian-directed installations on the basis of their technical abilities, it is intended that they should be free of the usual rotation-of-duty requirements and not have separate lines of reporting.

5. In addition to the recommendations above, we have given consideration to the possible establishment of a new kind of Government research and development establishment, which might be called a Government institute. Such an institute would provide a means for reproducing within the Government structure some of the more positive attributes of the nonprofit corporation. Each institute would be created pursuant to authority granted by the Congress and be subject to the supervision of a Cabinet officer or agency head. It would, however, as a separate corporate entity directly managed by its own board of regents, enjoy a considerable degree of independence in the conduct of its internal affairs. An institute would have authority to operate its own career merit system, as the Tennessee Valley Authority does, would be able to establish a compensation system based on the comparability principle, and would have broad authority to use funds and to acquire and dispose of property.

The objective of establishing such an instrumentality would be to achieve in the administration of certain research and development programs the kind of flexibility which has been obtained by Government corporations while retaining, as was done with the Government corporation, effective public accountability and control.

We regard this idea as promising and recommend that the Bureau of the Budget study it further, in cooperation with some of the agencies having major research and development programs. It may well prove to be a useful additional means for carrying out governmental research and development efforts.

6. It would seem, based on the results of this review, that it would be possible and desirable to make more use of existing governmental facilities and avoid the creation of duplicate facilities. This is not as easy a problem as it might seem. It is ordinarily necessary for a laboratory, if it is to provide strong and competent facilities, to have a major mission and a major source of funding. This will limit the extent to which it is possible to make such facilities available for the work of other agencies. Nevertheless, in some cases and to some extent it is clearly possible to do this and a continuing scrutiny is necessary in order to make sure that the facilities which the Government has are used to their fullest extent.

7. Finally, together with the better use of existing facilities, the Government must also make better use of its existing scientific and engineering personnel. This implies not only a careful watch over work assignments, but also a continual upgrading of the capabilities of Federal personnel through education and training. At the present time, technology is changing so rapidly that on-the-job scientists and engineers find themselves out of date after a decade or so out of the university. To remedy this, the Government must strengthen its educational program for its own personnel, to the extent of sending them back to the university for about an academic year every decade. This program, necessary as it is, will only become attractive if the employee is insured job security on his return from school and if his parent organization is allowed to carry him on its personnel roster.

ANNEX 1

THE WHITE HOUSE,
July 31, 1961.

HON. DAVID E. BELL,
Director, Bureau of the Budget,
Washington, D.C.

DEAR MR. BELL: Since the end of World War II, the Federal Government has been making extensive use of contracts with private institutions and enterprises to provide for the operation and management of research and development facilities and programs, for analytical studies and advisory services, and for technical supervision of weapons systems and other programs administered on a systems basis. Through such contracts the Government has been able to accomplish scientific and technical work essential to urgent public purposes.

In part, the use of such contracts has been made necessary by the Government's entry into new fields, such as atomic energy, missile development and space exploration, and the need for talents and services not previously employed. In part, the use of contracts has also been induced by the recommendations of the second Hoover Commission and other groups that the Government terminate activities which could better be performed for it by private enterprise. Present Federal policies with respect to contracting-out Government activities are outlined generally in Bureau of the Budget Circular No. A–49, "Use of Management and Operating Contracts," and Bureau of the Budget Bulletin No. 60–2, "Commercial-Industrial Activities of the Government Providing Products or Services for Governmental Use."

After a decade or more of experience with such contracts, I think it would be desirable to review the effectiveness of this means of accomplishing the Government's purposes. Some of the questions that require review have been posed recently in studies and reports by several committees of Congress. I would like to have you undertake, with the assistance and cooperation of the other Federal officials most concerned, a review of the experience with respect to the types of contracts mentioned above. I am requesting the following officials to participate in the study: the Secretary of Defense, the Chairman of the Atomic Energy Commission, the Chairman of the U.S. Civil Service Commission, the Administrator of the National Aeronautics and Space Administration, and the Special Assistant to the President for Science and Technology.

The product of the review should be recommendations to guide future executive branch action. While there is a consensus that the use of contracts is essential and appropriate to carry on certain types of Federal operations, it also appears that use of the contract device has been made necessary in part by the limitations which exist with respect to direct Federal operations. I would like to have you explore the circumstances and conditions under which contractor operations provide the most effective means for accomplishing the Government's

objectives in the areas under review. I would also like to have full consideration given to the limitations which make direct Federal operations difficult, and to the development of proposals for adjustments and new concepts in direct Federal operations which would provide the Government with greater flexibility in determining whether the public interest would best be served by the use of contractor or direct Government operations.

The review should focus on the following matters: (1) The effect of the use of contractors on direct Federal operations, the Federal personnel system, and the Government's own capabilities, including the capability to review contractor operations and carry on scientific and technical work in areas where the contract device has not been used, and policies and actions needed to increase the Government's capabilities in these respects; (2) the policies, if any, that the Government should follow in controlling the salaries and fringe benefits of personnel working under a contract, and the appointment, management and dismissal of such personnel; (3) the criteria to be used in determining whether to perform a service or function through a contractor or through direct Federal operations, including any special considerations to be given to the nature of the contractor and his relationship to production contractors; (4) the policies which should apply in selecting contractors, including the organization of institutions for the sole purpose of entering into contracts with the Government; (5) the means for reviewing and supervising contractor operations, and for achieving maximum efficiency in such operations; and (6) the policies which should apply with respect to contractor fees and cost reimbursement practices on items such as overhead, facilities and equipment, and advertising.

The results of the review should be available not later than December 1.

Sincerely,

JOHN F. KENNEDY.

ANNEX 2

SUMMARY INFORMATION CONCERNING RESPONDENTS TO BUREAU OF THE BUDGET QUESTIONNAIRE AND ORGANIZATIONS INTERVIEWED

This annex lists the respondents to the questionnaires sent out by the Bureau of the Budget in connection with the study of Government contracting for research and development. It presents certain data as to the types of organizations involved and their staff characteristics.

1. Departments and agencies

Ten departments and agencies, and some organizations attached to the Office of the Secretary of Defense,[1] were asked to respond to questionnaires concerning the means of conducting their research and development programs. The 10 were the Departments of the Army, Navy, Air Force, Agriculture, Commerce, and Health, Education, and Welfare, National Aeronautics and Space Administration, Atomic Energy Commission, National Science Foundation, and Federal Aviation Agency.

Those establishments were selected to participate in the study because of the magnitude and diversity of their research and development activities. Other departments and agencies, such as Interior and the Tennessee Valley Authority conduct significant R. & D. programs, but the 10 participants account for over 98 percent of Federal expenditures for research and development ($12,138 million out of a total $12,365 million estimated for fiscal year 1963). By the same token they employ the bulk of Federal scientists, engineers, and other personnel engaged in R. & D. and utilize the large majority of contractual services in support of such Federal programs.

The following table summarizes the scientific and engineering staff resources in the R. & D. programs of the 10 departments and agencies:

Technical professional R. & D. personnel [1]

	Military	Civilians	Total
Department of Defense	6,582	23,481	30,063
Other agencies	[2] 1,977	16,124	18,101
Total	8,559	[3] 39,605	48,164

[1] The following definitions were furnished to departments and agencies for reporting of these data. The definitions are consistent with National Science Foundation and Bureau of Labor Statistics practice.

Scientists: Count as scientists all persons actually engaged in scientific work at a level which requires knowledge of physical, life, engineering, or mathematical sciences equivalent at least to that acquired through completion of a 4-year college course with a major in one of these fields, regardless of whether they hold a college degree in the field. Include those persons in research-development, management, technical service, technical sales, and other positions which require them to use the indicated level of knowledge in their work. Do not include persons trained in science but currently employed in positions not requiring the use of such training. Exclude psychologists and social scientists.

Engineers: Count as engineers all persons actually engaged in chemical, civil, electrical, mechanical, metallurgical, and all other types of engineering work at a level which requires knowledge of engineering, physical, life, or mathematical sciences equivalent at least to that acquired through completion of a 4-year college course with a major in one of these fields, regardless of whether they hold a college degree in the field. Include those persons in research-development, management, technical service, technical sales, and other positions which require them to use the indicated level of knowledge in their work. Do not include persons trained in engineering, but currently employed in positions not requiring the use of such training. Include architectural engineers, exclude architects.

[2] Includes members of the Public Health Service.

[3] Includes 1,425 personnel employed under special authority such as Public Law 313, "excepted positions" for the NASA, and others.

[1] National Security Agency, Advanced Research Projects Agency, Defense Atomic Support Agency, Defense Communications Agency, Defense Intelligence Agency.

2. Government and contractor installations performing research and development

Seventy-one Government laboratories and other types of installations, universities, private businesses and not-for-profit institutions were asked to respond to questionnaires calling for presentation of information on the nature and amount of their work, personnel and personnel systems, and certain operating characteristics. They were selected from among the several thousand (the Department of Defense alone has contracts with over 300 universities and not-for-profit institutions) public and private enterprises engaged in doing R. & D. work for the Federal Government because of the significance of their activities and because they were representative of the variety of: (1) types of organization—Government-owned-and-operated laboratories, development centers and test ranges, and universities, university-associated research centers, Government-owned contractor-operated facilities, not-for-profit enterprises and industry; (2) fields of endeavor—physical and biological sciences, medicine, operations research, etc.; (3) primary functions—research, analytical services, systems engineering, testing, etc.; (4) organizations performing under various Government agency sponsoring arrangements; and (5) geographic locations. No attempt was made to select participants in the study on a statistical sample basis.

The significance, however, of the participating group is apparent in terms of their expenditures and staff resources. The non-Federal installations involved had expenditures for R. & D. of over $2.7 billion in fiscal year 1961 of which over 90 percent was received from Federal sources. The staffs of the Federal and contractor institutions (excluding universities, but including university-associated research centers) queried total about 250,000 people, including 77,000 Federal civilian and military employees.

The following tables indicate the type and size of organizations involved.

TABLE 1.—*Types of respondents*

The following table lists the 71 installations under two categories: direct Federal operations and contractors. "On campus" college and university respondents are identified as a group separately from other contractors. The other contractors are marked to indicate type according to the following: (1) university-associated institutions (i.e., a laboratory or division which has been separately organized by, but remains legally a part of, a university to handle certain major Government R. & D., efforts); (2) other not-for-profit institutions; (3) industry; and (4) Government-owned, contractor-operated facilities. There is overlap between the latter group and the others.

NOTE.—An asterisk (*) indicates those institutions whose officers were also interviewed by a Bureau of the Budget interview team, having representation from the Bureau, the office of the special assistant to the President for science and technology, the Civil Service Commission, and the department or agency primarily involved.

DIRECT FEDERAL OPERATIONS

*Ordnance Materials Research Office (U.S. Army).
U.S. Army Chemical Research and Development Laboratories.
Army Rocket and Guided Missile Agency Research Laboratories.
*U.S. Army Signal Research and Development Laboratory, Fort Monmouth.
White Sands Missile Range (U.S. Army).
Diamond Ordnance Fuze Laboratories (U.S. Army).
Walter Reed Army Institute of Research.
*U.S. Naval Research Laboratory.
U.S. Naval Ordnance Laboratories:
White Oak.
Corona.
*U.S. Naval Ordnance Test Station.
Pacific Missile Range (including organizational elements primarily at Point Mugu and Point Arguello).
Aeronautical Systems Division, Air Force Systems Command.
*Air Force Cambridge Research Laboratories.
Rome Air Development Center (U.S. Air Force).
Air Force Flight Test Center, Edwards Air Force Base.
Office of the Deputy Commander for Aerospace Systems, including the Ballistic Systems Division and the Space Systems Division (U.S. Air Force).
Langley Research Center (NASA).
Goddard Space Flight Center (NASA).
*Ames Research Center (NASA).
Weather Bureau (Commerce).
*National Bureau of Standards (Commerce).
National Aviation Facilities Experimental Center (FAA).
Regional Poultry Research Laboratory (Agriculture).
U.S. Salinity Laboratory (Agriculture).
U.S. Vegetable Breeding Laboratory (Agriculture).
Fresno Horticultural Field Station (Agriculture).
Forest Products Laboratory (Agriculture).
Northern Utilization R. & D. Division (Agriculture).
*National Institutes of Health (HEW).
Robert A. Taft Sanitary Engineering Center (HEW).

CONTRACTORS

Colleges and universities:
*Massachusetts Institute of Technology.
New Mexico State University.
*California Institute of Technology.
Michigan State University.
Georgia Institute of Technology.

OTHER CONTRACTORS

Title of organization	University associated	Not for profit	GO-CO[1]	Industry
*Lincoln Laboratory (MIT)	X			
Operations Evaluation Group (MIT)	X			
Hudson Laboratories (Columbia University)	X			
*Applied Physics Laboratory (Johns Hopkins University)	X			
Institute of Science and Technology, University of Michigan	X			
MITRE Corp		X		
Institute for Defense Analyses		X		
*Rand Corp		X		
Vitro Laboratories, Division of Vitro Corp. of America				X
*Research Analysis Corp		X		
System Development Corp		X		
Analytic Services, Inc		X		
*Aerospace Corp		X		
Stanford Research Institute		X		
*Space Technology Laboratories, Inc				X
Cornell Aeronautical Laboratory, Inc		X		
*Bell Telephone Laboratories, Inc		X		
Thiokol Chemical Co., Redstone Division			X	X
Boeing Co., Aero-Space Division				X
Martin Marietta Corp., Aerospace Division				X
*Lockheed Missiles & Space Co				X
Land-Air, Inc., White Sands, Holloman Division				X
Pacific Missile Range (Bendix Corp., Radio Division)				X
Atlantic Missile Range (Pan American World Airways, Guided Missiles Range Division)				X
*Tullahoma Test Facility (ARO, Inc.)			X	X
*Rocketdyne, a division of North American Aviation, Inc				X
*Jet Propulsion Laboratory (California Institute of Technology)	X		X	
*Brookhaven National Laboratory (Associated Universities, Inc.)		X	X	
*Oak Ridge National Laboratory (Union Carbide)			X	X
Los Alamos Scientific Laboratory (University of California)	X		X	
Sandia Corp. (Western Electric Co.)			X	X
Bettis Atomic Power Laboratory (Westinghouse)			X	X
Idaho Test Station (Phillips Petroleum Co., Atomic Energy Division)				X
Nevada Test Site (Reynolds Electrical & Engineering Co., Inc)				X
National Radio Astronomy Observatory (Associated Universities, Inc.)		X	X	

*In addition, officers of the following private institutions were interviewed: Jerrold Electronics Corp. General Atronics Corp., CEIR, Inc., and the University of Chicago.

[1] Government owned and contractor operated.

TABLE 2.—*Total staff reported by contractor and direct Federal operation establishments performing research and development operations*

Group	Total staff	Scientists and engineers	Other technical and management	Other
Contractors [1]	171,935	38,535	57,174	76,226
Government	77,071	21,880	22,298	32,893
Civilian	(62,837)	(18,575)	(18,556)	(25,706)
Military	(14,234)	(3,305)	(3,742)	(7,187)
Total	[2] 249,006	[3] 60,415	[4] 79,472	109,119

[1] Exclusive of colleges and universities ("on campus" contracts).
[2] Questionnaire requested the reporting of full-time personnel employed on or about Sept. 30, 1961.
[3] Includes 981 individuals classified by respondents as executives, as defined in the questionnaire as follows: "Executives (highest levels of management, either line or staff, not directly and necessarily involved in the scientific and engineering aspects of work in progress)."
Also includes 7,681 personnel classified by respondents as scientists and engineers who do not have academic degrees. These individuals are not included in the salary analysis for the reason that respondents were asked to tabulate staff salaries since year of bachelors degree.
[4] Defined in the questionnaire as follows: "Other technical and management personnel (including such personnel as accountants, attorneys, personnel specialists, technical support personnel, draftsmen, engineering aides, technicians, and laboratory assistants, but excluding clerks, typists, janitors, etc.)."

TABLE 3.—*Staff reported, by contractor*

Contractor [1]	Total staff	Scientists and engineers [2]
Lincoln Laboratory	1,805	666
Operations Evaluation Group	173	98
Institute of Science and Technology (University of Michigan)	620	268
Hudson Laboratories	254	102
Applied Physics Laboratory (Johns Hopkins University)	2,002	787
MITRE Corp	1,476	424
Institute for Defense Analyses	357	146
Rand Corp	1,036	464
Vitro Laboratories Division of Vitro Corp. of America	2,663	516
Research Analysis Corp	418	96
System Development Corp	3,827	1,839
Analytic Services Inc	70	45
Aerospace Corp	3,053	886
Stanford Research Institute	1,727	843
Space Technology Laboratories, Inc	4,569	1,749
Cornell Aeronautical Laboratory, Inc	1,027	400
Bell Telephone Laboratories, Inc	12,794	4,543
Thiokol Chemical Co. Redstone Division	1,679	369
Boeing Co. Aerospace Division	42,180	5,695
Martin-Marietta Corp. Aerospace Division	13,394	2,309
Lockheed Missiles & Space Co	26,183	4,892
Land-Air Inc. (WSMR-Holloman)	550	161
Bendix Corp. Radio Division at PMR	207	20
Pan American World Airways Guided Missiles Range Division	5,730	601
Rocketdyne	12,197	1,719
Jet Propulsion Laboratory	2,867	963
Brookhaven National Laboratory	2,402	672
Oak Ridge National Laboratory	4,193	1,549
Los Alamos Scientific Laboratory	3,389	1,300
Sandia Corp	7,888	2,068
Bettis Atomic Power Laboratory	3,598	1,149
Phillips Petroleum Co. Atomic Energy Division (Idaho test station)	1,747	517
Reynolds Electrical & Engineering Co. Inc. (Nevada test site)	2,906	45
ARO Inc. (Tullahoma test facility)	2,851	610
National Radio Astronomy Observatory	103	24

[1] Exclusive of colleges and universities ("on campus contracts").
[2] Includes those individuals classified by respondents as "executives."

TABLE 4.—*Staff reported, by Government-operated laboratory, test station, or range*

Organization	Total staff		Scientists and engineers [1]	
	Civilian	Military	Civilian	Military
Ordnance Materials Research Office	80	1	52	1
Army chemical R. & D. laboratories	1,106	377	389	208
Army Rocket and Guided Missile Agency research laboratories	480	41	257	0
Army Signal R. & D. laboratory, Fort Monmouth	2,920	501	1,130	181
White Sands Missile Range	4,874	3,271	1,009	125
Diamond ordnance fuse laboratories	1,369	5	487	0
Walter Reed Army Institute of Research	455	326	192	182
Naval Research Laboratory	3,214	84	1,023	17
Naval ordnance laboratories:				
White Oak	3,084	49	959	14
Corona	999	3	406	3
Naval ordnance test station	4,648	1,018	1,228	29
Pacific Missile Range	3,152	2,412	398	53
Aeronautical Systems Division, Aeronautical Systems Command	7,879	1,664	2,658	856
Air Force Cambridge research laboratories	848	200	426	93
Rome Air Development Center	1,214	351	481	137
Air Force Flight Test Center, Edwards AFB	2,129	2,528	104	104
Air Force, Office of Aerospace Systems	2,196	1,403	212	1,302
Langley Research Center	3,416	0	1,249	0
Goddard Space Flight Center	1,725	0	624	0
Ames Research Center	1,512	0	516	0
Weather Bureau	511	0	275	0
National Bureau of Standards	3,396	0	1,516	0
National Aviation Facilities Experimental Center	1,188	0	348	0
U.S. Vegetable Breeding Laboratory	19	0	5	0
U.S. Salinity Laboratory	43	0	19	0
Fresno Horticultural Field Station	10	0	6	0
Regional Poultry Research Laboratory	35	0	11	0
Northern Utilization R. & D. Division	384	0	201	0
Forest Products Laboratory	427	0	156	0
National Institutes of Health	8,660	0	1,916	0
Robert A. Taft Sanitary Engineering Center	864	0	322	0

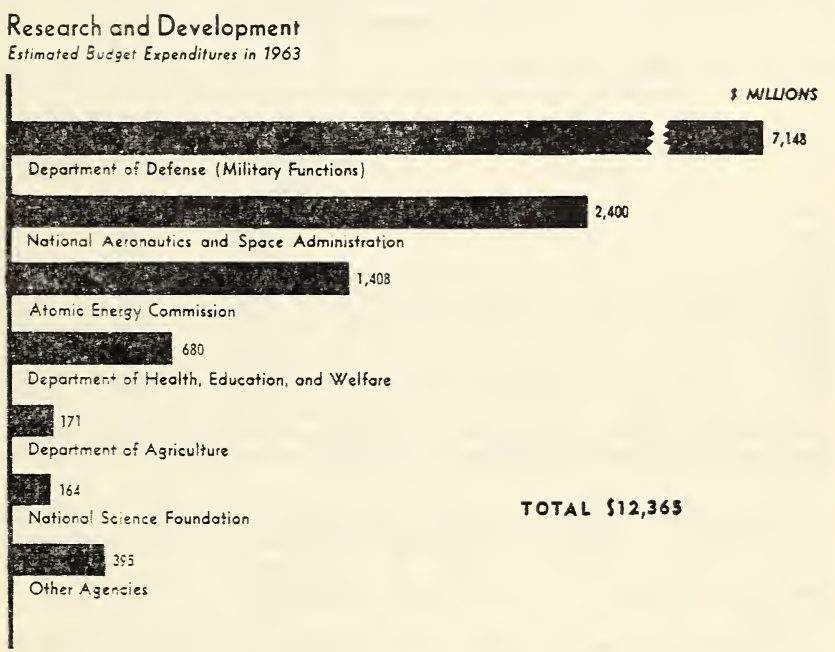
[1] Includes those individuals classified by respondents as "executives."

ANNEX 3

Special Analysis G

FEDERAL RESEARCH AND DEVELOPMENT PROGRAMS

This analysis summarizes Federal expenditures in the fiscal years 1961, 1962, and 1963 for the conduct of research and development and for the construction, improvement, and equipping of research and development facilities.[1]



Net budget expenditures for research and development in 1963 are estimated to total $12,365 million, an increase of $2,121 million over 1962 and $3,074 million over 1961.

[1] The term "Conduct of research and development" includes activities in which the primary aim is either to develop new knowledge or to apply existing knowledge to new uses. These activities may be carried out in Government installations or in the facilities of private, State, or local organizations using Federal funds. Generally excluded from this definition are expenditures for routine testing, experimental production, information activities, and training programs. This analysis also omits expenditures for research performed independently by contractors within overhead arrangements on some procurement contracts funded in Department of Defense procurement accounts and for the collection of general-purpose statistics by the Census Bureau and other agencies.

Expenditures for "Research and development facilities" include amounts for physical facilities such as land, buildings, and major equipment, regardless of whether the facility is to be used or owned by the Federal Government or by a private, State, or local organization.

TABLE G–1.—*Total Federal research and development expenditures*

[In millions of dollars]

Purpose	1961 actual	1962 estimate	1963 estimate
Conduct of research and development	8,754.0	9,618.0	11,475.9
Research and development facilities	536.8	625.9	889.4
Total	9,290.8	10,243.9	12,365.3

NOTE.—Totals in text tables may not add due to rounding.

Through its programs the Federal Government now supports over two-thirds of the research and development of the Nation. Of the total Federal expenditures for this purpose about two-thirds are made through contracts with private industry; over 10% through grants and contracts with universities and other nonprofit institutions; and the remainder by Government scientists in Federal facilities.

TABLE G–2.—*Federal expenditures for research and development divided between national defense and other programs, fiscal years 1953–63*

[In millions of dollars]

Fiscal year	National Defense	Other	Total
1953	2,832	269	3,101
1954	2,868	280	3,148
1955	2,979	289	3,268
1956	3,104	332	3,435
1957	4,027	433	4,460
1958	4,463	523	4,985
1959	5,048	744	5,792
1960	6,639	1,103	7,742
1961	7,719	1,572	9,291
1962	7,820	2,424	10,244
1963	8,572	3,793	12,365

NOTE.—Amounts included in this table under "National Defense" for the Department of Defense have been compiled from the best available summary data to provide maximum possible comparability for the years shown.

Within the totals for research and development, expenditures for basic research will increase to about $1.6 billion in 1963 as compared with well over $1 billion in 1962. A major portion of the increase in 1963 is attributable to the National Aeronautics and Space Administration.

Included in this analysis, but not separately identified, are the funds of a number of agencies in certain scientific fields of broad national interest. These include space programs, medical and related research, and several fields which have been given special attention by the Federal Council for Science and Technology and its committees, including oceanography, atmospheric sciences, high and low energy physics, and materials and water research.

Space programs.—Expenditures for space research and development will amount to about $3.7 billion in 1963 as compared with about $2.3 billion in 1962 and $1.5 billion in 1961. A better index of the growth of Federal activities in this field is shown by the new obligational authority for all space activities summarized in table G–3.

The amounts shown for the National Aeronautics and Space Administration cover all activities of that agency except those specifically identified with aircraft or missile technology. The estimates

for the Department of Defense include all the principal amounts identifiable with the Department's space programs but exclude certain amounts which cannot feasibly be separated from other military expenses, such as the development of missiles which are also used in the space programs, military personnel costs, and various other operating costs. For the Atomic Energy Commission, the table includes the amounts associated with the development of nuclear rocket propulsion and nuclear power sources for space applications. The Weather Bureau amounts are primarily those related to the establishment of an operational meteorological satellite system, which, therefore, are not included in the totals for research and development in this special analysis. The amounts for the National Science Foundation are for a space telescope project.

TABLE G–3.—*New obligational authority for Federal space programs*

[In millions of dollars]

Agency	1961 actual	1962 estimate	1963 estimate
National Aeronautics and Space Administration	926.2	1,786.3	3,732.9
Department of Defense	793.8	1,147.2	1,517.7
Atomic Energy Commission	63.2	120.1	192.9
Department of Commerce: Weather Bureau		50.2	47.2
National Science Foundation	.6	1.6	1.7
Total	1,783.8	3,105.4	5,492.4

Medical Research.—The Federal Government now supports over three-fifths of the medical and health-related research of the Nation. Total obligations of Federal agencies for the conduct of such research and for research facilities are estimated at $1,024 million in 1963 as compared with $857 million in 1962 and $623 million in 1961.

The rapid growth in the Federal support of medical and health-related research reflects chiefly the increases in the Department of Health, Education, and Welfare, particularly for intramural and research grants programs of the National Institutes of Health, which presently account for about two-thirds of the Federal support of medical research and roughly two-fifths of national expenditures in this field.

The major field of interest to the Atomic Energy Commission is research on the effects of radiation on human beings. Medical research in the Department of Defense emphasizes preventive medicine and medical problems of military operations. The Veterans Administration undertakes clinical research related to the special problems of patient care in its hospitals. A portion of the rapidly growing research programs of the National Aeronautics and Space Administration is directly related to health, particularly the effects of space flight on humans. Research programs of the Department of Agriculture include such fields as nutrition and veterinary medicine. The National Science Foundation supports basic research in the life sciences, a portion of which is of direct significance to health.

TABLE G–4.—*Obligations of Federal agencies for medical and health related research*

[In millions of dollars]

Agency	1961		1962		1963	
	Budgeted as medical and health related	Directly related [1]	Budgeted as medical and health related	Directly related [1]	Budgeted as medical and health related	Directly related [1]
Department of Health, Education, and Welfare:						
Public Health Service	434	----------	613	----------	735	----------
National Institutes of Health	(410)	----------	(562)	----------	(679)	----------
Other	13	----------	20	----------	21	----------
Total, Department of Health, Education, and Welfare	447	----------	633	----------	756	----------
Department of Defense	22	28	32	31	43	41
Atomic Energy Commission	7	54	8	61	8	71
National Aeronautics and Space Administration	----------	5	----------	22	----------	29
Veterans' Administration	24	----------	32	----------	32	----------
Department of Agriculture	----------	19	----------	23	----------	22
National Science Foundation	----------	14	----------	14	----------	17
Other	3	----------	1	----------	4	1
Total, medical and health related research	503	120	706	151	843	181
Total, conduct of research	(459)	(111)	(650)	(140)	(750)	(169)
Total, research facilities	(44)	(9)	(56)	(12)	(93)	(11)

[1] Includes obligations for research with other than medical or health objectives but related to health in terms of substance or probable applications.

Oceanography.—The national oceanographic program of the Federal Government for 1963 will total $123.6 million in obligations.

TABLE G–5.—*Obligations of Federal agencies for oceanographic research and surveys*

[In millions of dollars]

Agency	1961 actual	1962 estimate	1963 estimate
Departments of—			
Commerce	11.4	23.0	23.9
Defense	31.6	42.1	57.3
Health, Education, and Welfare	.7	1.3	1.6
Interior	8.7	14.2	14.9
Atomic Energy Commission	1.7	3.6	5.4
National Science Foundation	7.9	16.7	20.1
Other	.1	.1	.4
Total	62.1	101.0	123.6

An estimated $53.1 million for research and instrumentation will provide for studies by the Navy particularly of the physical and chemical properties of the sea; grants of the National Science Foundation for oceanography including marine biology; the work of the AEC related principally to radiation and atomic wastes; and research by Department of the Interior on commercial fish resources. Survey programs, principally those of the Departments of Commerce and Navy to map and provide basic statistics on depths, currents, temperatures and related data, will total $17.1 million. Funds for the construction of ships and facilities will total $49.1 million. Also included is $3.7 million for the International Indian Ocean Expedition and $0.6 million for the National Oceanographic Data Center.

Atmospheric sciences.—The atmospheric sciences are undergoing rapid development as an increasing array of new techniques become available to obtain and process data bearing on atmospheric properties and dynamics. The Federal Government's program in this field is estimated to grow to over $200 million in 1963, roughly double the past year's effort. Almost one-half of the increase in 1963 is being directed to the meteorological and scientific satellite programs of the National Aeronautics and Space Administration. Other increases have been required by the rigorous needs of new defense programs, detection and prediction of radioactive fallout, air pollution, and aviation and air-traffic control as well as the desire to advance the science generally through basic research grants and facilities. A notable step to be taken in 1963 will be the financing by the National Science Foundation of a major construction and operating program for the National Center for Atmospheric Research.

High and low energy physics.—High energy physics is concerned with the study of elementary particles at the subatomic level and related nuclear forces. It is characterized by high costs for high energy particle accelerators and related equipment. In 1963, total Federal expenditures for high energy physics research and construction are estimated to be $138 million—of which the Atomic Energy Commission's share is $126 million—as compared with a total of $109 million in 1962 and $86 million in 1961. The balance is chiefly accounted for by the Department of Defense and the National Science Foundation.

Low energy physics is concerned with the structure and properties of the nucleus of the atom and the character of related nuclear processes. The research is conducted primarily with particles produced from relatively small accelerators and research reactors. Total Federal expenditures for low energy physics in 1963 are estimated at $61 million—of which Atomic Energy Commission will provide $40 million and the National Science Foundation $14 million—as compared with a total of $52 million in 1962 and $39 million in 1961. The balance is chiefly accounted for by the Departments of Defense and Commerce.

Materials research.—Attention has been given over the past 2 years to strengthening materials research with emphasis on basic research and related graduate education. While no overall figures are available, basic materials research is being given increased support particularly through Federal financing of interdisciplinary materials research laboratories on a number of major campuses.

Water research.—A long range study of future needs for research in natural resources has been initiated by this administration. Particular attention has been given in recent months to Federal programs in water research. While no precise estimates are available, this budget provides for a significant strengthening of several agency programs in water research particularly in the Department of the Interior.

In the following paragraphs are described the programs of the Federal agencies with the largest expenditures for research and development. The expenditures for these and other agencies are listed separately in the table at the end of this text.

DEPARTMENT OF DEFENSE—MILITARY FUNCTIONS

The research, development, test, and evaluation programs of the Department of Defense include basic research in the sciences, applied

research, and technical developments; development of new weapons and equipment; fabrication and procurement of items under development for test and evaluation; and construction, operation, and maintenance of laboratories and test facilities.

TABLE G–6.—*Expenditures of the Department of Defense—Military functions for research and development*

[In millions of dollars]

Function, purpose, and budget title	1961 actual	1962 estimate	1963 estimate
Conduct of research and development:			
Research, development, test, and evaluation	6,130.5	6,039.2	6,650.1
Procurement	130.3	141.7	134.9
Military personnel	205.1	206.1	206.6
Civil Defense		10.0	17.0
Total, expenditures for the conduct of research and development	6,465.9	6,397.0	7,008.6
Research and development facilities	115.9	82.3	139.7
Total, expenditures for research and development	6,581.8	6,479.3	7,148.3

The present high levels of effort in basic research and applied research will be augmented in 1963 in certain areas to exploit new possibilities that are emerging and to place further emphasis in areas of fundamental importance to military applications. The planned expenditures will also carry forward the development of a wide variety of major weapon systems and other specific developments for which the annual requirements fluctuate depending on the status of development, the phasing of the effort, and the quantities and cost of the test articles required.

Estimates of expenditures for research and development facilities of the Department of Defense shown in table G–6 include the amounts in the military construction programs for technical facilities having as their primary mission, research, development, or testing functions. The expenditure pattern indicated for the 3 years results from heavy expenditures for the Nike-Zeus test facilities in 1961 and the substantial expenditures for the large radar telescope at Sugar Grove, W. Va., which are estimated to occur in 1963.

The composition of and trends in the programs of the Department are shown in terms of obligations by major fields of effort in table G–7.

Missile development, including an emphasis in the field of defense against ballistic missiles under the Army's Nike-Zeus anti-missile project, continues in 1963 to represent the largest area of activity. The decrease within this field is caused primarily by the trend in major intercontinental ballistic missile programs for which 1961 was the year in which the highest obligations were required. In the strategic area, the Navy's Polaris system is continued at a high level as are the Air Force Minuteman and Skybolt programs. The initiation of development effort for a mobile midrange ballistic missile is included in the 1963 program. The decrease in the missile field is approximately offset by the increases estimated for military astronautics and related equipment. The 1963 estimates provide for the initiation of a new multipurpose space booster vehicle for the national space program. Provision is also made for programs for the development of satellite systems in support of military requirements, together

with essential supporting research and development on subsystems and components. Requirements in the field of aircraft development remain comparatively high due to the new multipurpose tactical fighter-bomber aircraft and the B–70 prototype aircraft in Air Force, the new jet cargo aircraft for the Military Air Transport Service, the triservice vertical takeoff and landing aircraft, and mobility and surveillance aircraft types for the Army.

TABLE G–7.—*Obligations of the Department of Defense—Military functions for research and development*

[In millions of dollars]

Purpose, budget title and program	1961 actual	1962 estimate	1963 estimate
Conduct of research and development:			
Research, development, test, and evaluation:			
Military sciences	620.5	785.5	964.4
Aircraft and related equipment	680.3	630.3	690.9
Missiles and related equipment	3,194.8	2,640.0	2,386.0
Military astronautics and related equipment	608.6	1,058.5	1,327.4
Ships and small craft and related equipment	212.9	211.3	234.4
Ordnance, combat vehicles, and related equipment	168.1	191.1	221.9
Other equipment	443.0	532.7	801.5
Programwide management and support	236.8	239.9	268.4
Emergency fund		99.5	150.0
Total, direct obligations, research, development, test, and evaluation	6,165.0	6,388.8	7,044.9
Procurement:			
Aircraft	112.7	71.2	8.2
Missiles	13.4	12.8	
Ships	40.1	31.0	78.6
Other	3.7		
Total, direct obligations, procurement	169.9	115.0	86.8
Military personnel	205.1	206.1	206.6
Civil defense		15.5	17.0
Total, direct obligations for the conduct of research and development	6,540.0	6,725.0	7,355.3
Research and development facilities	113.1	93.0	106.0
Total, direct obligations for research and development	6,653.1	6,818.4	7,461.3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

All of the activities of the National Aeronautics and Space Administration are classified as research and development for purposes of this special analysis. The NASA is responsible for the development, test, and operation of space vehicles for manned and unmanned exploration of space and other non-military applications, and for conducting the broad programs of supporting research and development required for these purposes. In addition NASA is responsible for conducting research to advance aircraft and missile technology in support of both military and civil interests.

TABLE G–8.—*Expenditures of the National Aeronautics and Space Administration for research and development*

[In millions of dollars]

Function and purpose	Conduct of research and development			Research and development facilities		
	1961 actual	1962 estimate	1963 estimate	1961 actual	1962 estimate	1963 estimate
Manned space flight	231.7	437.7	997.0	5.6	33.5	165.3
Space applications	14.9	77.8	135.0	1.3	4.0	2.8
Unmanned investigations in space	208.4	312.1	462.1	7.7	21.4	33.0
Space technology	122.8	207.5	342.5	19.4	27.7	49.5
Aircraft and missile technology	35.8	40.1	50.1	14.5	17.7	5.7
Supporting operations	32.5	71.0	128.5	49.7	49.5	28.5
Total, National Aeronautics and Space Administration	646.1	1,146.2	2,115.2	98.2	153.8	284.8

Expenditures for manned space flight support programs which will lead to manned lunar landing and return within this decade. Expanded effort will be devoted to the two methods now under consideration to achieve this goal—direct ascent from the earth to the moon and the use of the rendezvous technique to bring large spacecraft components together in earth orbit, after which the combined spacecraft would continue to the moon. Propulsion development, spacecraft development, ground testing and launching required to carry out the Saturn, Advanced Saturn, Apollo, and Nova programs are also provided for. The space application program includes funds for research and development on the Tiros and Nimbus meteorological satellites and the Rebound, Relay, and Syncom communication satellites. Major emphasis in the unmanned investigations in space will be devoted to earth orbiting geophysical, astronomical, and solar observatories; lunar exploration with the Ranger and Surveyor programs; and planetary exploration with the Mariner series. Funds for space technology provide for a variety of technological advancements including development of advanced propulsion systems and electric power techniques and systems for future space vehicles. Aircraft and missile technology includes activities for basic and applied research on problems related to design, development, construction, and operation of aircraft and missiles. It includes research on new types of military and commercial aircraft, as well as on techniques of aerodynamic flight which may prove applicable to space travel. Supporting operations include the development and operation of the worldwide tracking and data acquisition networks required for the civilian space programs.

ATOMIC ENERGY COMMISSION

The research and development program of the Atomic Energy Commission, including supporting construction, constitutes nearly half of the Commission's total annual expenditures. Basic research is conducted in the physical and life sciences to secure a better understanding of nuclear processes and of the effects of nuclear radiation on living organisms. The Commission's applied research and development program includes efforts to improve the processes used in the production of special nuclear materials, to develop improved types of nuclear weapons, and to find ways of obtaining useful power from nuclear reactions.

While a large portion of the development effort is aimed at military uses of atomic energy, an increasing portion is devoted to civilian applications. However, much of the information from military programs is applicable to peaceful uses. The research and development programs are carried on in the Commission's contractor-operated laboratories, in universities and other private research institutions, and by industrial contractors. In support of the actual conduct of research and development the Commission provides necessary facilities, including laboratories, particle accelerators, research and test reactors, and other test facilities.

TABLE G–9.—*Expenditures of the Atomic Energy Commission for research and development*

[In millions of dollars]

Function and program	Conduct of research and development			Research and development facilities		
	1961 actual	1962 estimate	1963 estimate	1961 actual	1962 estimate	1963 estimate
Special nuclear materials and weapons	240.0	412.2	393.5	13.9	16.7	17.0
Reactor development	399.9	408.3	463.2	125.8	87.6	97.5
Physical research	142.2	156.9	182.7	47.2	61.7	65.5
Biology and medicine	50.2	58.5	67.4	3.4	5.2	3.5
Other research and development	10.7	13.5	14.9	1.3	1.4	.5
Major operating equipment not included above				69.5	101.0	102.0
Total, Atomic Energy Commission	843.0	1,049.4	1,121.6	261.1	273.6	286.1

The principal increases in 1963 occur in the reactor development and physical research programs.

The reactor development program comprises primarily efforts to develop reactors for the economic generation of electric power, for propulsion of submarines and naval ships, for propulsion of rockets (Project Rover), and for auxiliary long-lived power sources for satellites and space vehicles (Project SNAP). The space applications (Projects Rover and SNAP) will be expanded substantially in 1963.

The physical research program, which also increases in 1963, comprises research in high and low energy physics and in those aspects of chemistry, metallurgy, and mathematics of particular importance to nuclear science and technology. Included also is a continuing program to achieve a controlled thermonuclear reaction.

The "other research and development" item includes the isotopes development program, which is directed toward utilization of radioisotopes and radiation for a variety of useful purposes, and Project Plowshare, a program to develop peaceful uses of nuclear explosives.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

The expenditures in the Department of Health, Education, and Welfare for research will total an estimated $679.9 million in 1963, as compared with $558.2 million in 1962, and $383.6 million in 1961.

The principal research effort of the Department is the support of medical research by the Public Health Service, particularly the National Institutes of Health. The major increases in National Institutes of Health research expenditures in 1963 are for the con-

tinuation of previously approved research projects and for the support of a larger number of clinical research centers. Elsewhere in the Public Health Service, research programs in community and environmental health will increase.

The research programs of the Office of Vocational Rehabilitation, the Food and Drug Administration, and the Office of Education will also be strengthened in 1963.

DEPARTMENT OF AGRICULTURE

The expenditures of the Department of Agriculture for research and development are estimated at $170.7 million in 1963 as compared with $157.6 million in 1962 and $141.8 million in 1961.

The largest program of the Department is that of the Agricultural Research Service which conducts research on the production of animals and crops, soil and water conservation, the utilization of farm products, agricultural engineering, human nutrition, and consumer use of agricultural products. Similar research is supported in the experiment stations of the land grant universities through grants of the Cooperative State Experiment Station Service.

Other research programs are undertaken in the Department by the Forest Service, the Economic Research Service, the Agricultural Marketing Service, the Foreign Agricultural Service, the Farmer Cooperative Service, and the National Agricultural Library.

The expenditures of the Department in 1963 include additional funds to initiate a program of project grants to universities and other nonprofit institutions for basic research and to complete staffing of the Department's new laboratories.

NATIONAL SCIENCE FOUNDATION

The total expenditures of the National Science Foundation for research and research facilities are estimated at $163.9 million in 1963 as compared with $124.3 million in 1962 and $81.9 million in 1961.

The 1963 budget will provide increased support for basic research project grants, the Antarctic research program, U.S. participation in the International Indian Ocean Expedition, and for a program of research in the geology and geophysics of the deeper layers of the earth. Additional funds are also estimated in 1963 for radio and optical astronomy observatories; a national center for atmospheric research; oceanographic ships and shore facilities; specialized biological and social science research facilities; and for university nuclear research facilities, computers, and atmospheric research facilities. Further, the Foundation is planning to increase its program of matching grants for the modernization of graduate laboratories at universities.

DEPARTMENT OF THE INTERIOR

The 1963 expenditures of the Department for research and development are estimated at $128.8 million, compared with $107.3 million in 1962, and $92.9 million in 1961. These expenditures are directed primarily to the conservation and utilization of the Nation's natural resources. The increases in 1963 are primarily in the Geological Survey's programs of hydrology, geology, and marine geology; the Bureau of Mines' research on extractive metallurgy; the coal research of the Office of Coal Research; the expanded biological research

activities of the Fish and Wildlife Service, and the Office of Saline Water's program of research to reduce the cost of converting salt water to fresh water.

DEPARTMENT OF COMMERCE

In 1963 the expenditures of the Department of Commerce for research and development are estimated at $90.8 million as compared with $48.0 million in 1962 and $30.8 million in 1961. Of the increase of $42.8 million in 1963, $30.7 million is for the construction of facilities chiefly to complete the new center for the National Bureau of Standards at Gaithersburg, Md.

A variety of research programs are conducted by the Department of Commerce—some in support of the missions of constituent bureaus and others to meet general needs of the Nation's science and industry. In the latter category are the programs of the National Bureau of Standards, which serves not only as the national laboratory for standardization and development of measurement techniques but also as a center for specialized research services in radio propagation, computer techniques, building technology, and cryogenics engineering.

A new program in 1963 is the research and technical assistance activities of the Area Redevelopment Administration.

TABLE G–10.—*Net budget expenditures for Federal research and development programs, based on existing and proposed legislation*

[In millions of dollars]

Description	Functional code	Conduct of research and development			Research and development facilities		
		1961 actual	1962 estimate	1963 estimate	1961 actual	1962 estimate	1963 estimate
Executive Office of the President:							
Office of Emergency Planning	050	2.0					
	900	1.2	1.3	0.2			
Total, Executive Office of the President		3.3	1.3	.2			
Funds appropriated to the President:							
Expansion of Defense Production: General Services Administration	050	.2	(1)				
Foreign assistance—economic: Agency for International Development	150	2.2	6.9	17.8	2.4	4.0	1.6
Special foreign currency programs: Translation of publications and scientific cooperation	350	1.1	3.6				
Total, funds appropriated to the President		3.5	10.5	17.8	2.4	4.0	1.6
Department of Agriculture:							
Agricultural Research Service	350	73.9	75.3	81.1	6.0	5.6	6.2
Cooperative State Experiment Station Service	350	32.7	35.8	38.2			
Economic Research Service	350		7.9	10.5			
Agricultural Marketing Service	350	9.8	7.2	6.1	(1)	.1	1.6
Forest Service	400	17.5	21.4	23.1	1.0	3.0	2.0
Other	350	.9	1.3	1.8			
Total, Department of Agriculture		134.8	148.9	160.9	7.0	8.7	9.8

See footnote at end of table, p. 44.

TABLE G-10.—*Net budget expenditures for Federal research and development programs, based on existing and proposed legislation*—Continued

[In millions of dollars]

Description	Functional code	Conduct of research and development			Research and development facilities		
		1961 actual	1962 estimate	1963 estimate	1961 actual	1962 estimate	1963 estimate
Department of Commerce:							
Area Redevelopment Administration	500		.9	1.8			
Maritime Administration	500	4.5	5.5	8.0			
National Bureau of Standards	500	16.6	19.2	25.4	2.9	11.4	40.7
Weather Bureau	500	4.5	8.2	10.3	.5	.2	1.6
Other	500	1.8	2.5	3.0			
Total, Department of Commerce		27.3	36.4	48.5	3.4	11.6	42.3
Department of Defense:							
Military functions	050	6,465.9	6,397.0	7,008.6	115.9	82.3	139.7
Military assistance	050	31.0	17.9	16.0			
Civil functions	400	2.4	2.5	2.7			
Total, Department of Defense		6,499.3	6,417.4	7,027.3	115.9	82.3	139.7
Department of Health, Education, and Welfare:							
Food and Drug Administration	650	3.1	3.5	4.1	(1)	0.3	1.5
Office of Education	700	11.1	11.2	20.6			
Office of Vocational Rehabilitation	650	7.5	10.6	12.2			
Public Health Service	650	329.7	494.5	583.4	30.9	35.6	54.1
Social Security Administration	650	1.2	2.5	4.0			
Total, Department of Health, Education, and Welfare		352.7	522.3	624.3	30.9	35.9	55.6
Department of the Interior:							
Geological Survey	400	42.2	46.0	54.0			
Bureau of Mines	400	23.8	24.8	24.9	.5	1.0	2.0
	650	.9	.9	1.5			
Fish and Wildlife Service	400	19.2	23.3	26.5	1.6	1.8	5.9
Office of Saline Water	400	1.9	1.4	6.3	1.5	5.0	2.7
Other	400	1.4	3.1	5.0			
Total, Department of the Interior		89.4	99.5	118.1	3.5	7.9	10.6
Department of Labor	650	2.4	3.7	4.5			
Post Office Department	500	6.3	8.6	10.7			
Department of State	150		.8	3.7			
Treasury Department:							
Bureau of Engraving and Printing	900	.3	.3	.3			
Coast Guard	500	.7	.7	.8			
Total, Treasury Department		1.0	1.0	1.1			
Atomic Energy Commission	050	843.0	1,049.4	1,121.6	261.1	273.6	286.1
Federal Aviation Agency	500	49.8	57.0	73.5	1.5	1.9	3.4
Housing and Home Finance Agency	550	(1)	.3	.8			
National Aeronautics and Space Administration	250	646.1	1,146.2	2,115.2	98.2	153.8	284.8
Veterans' Administration	800	18.5	23.2	24.3	.9	2.2	4.0
Civil Service Commission	900	.2	.2	.2			
National Science Foundation	700	70.5	84.5	116.0	11.4	39.8	47.9
Smithsonian Institution	700	1.3	1.6	2.5			
Tennessee Valley Authority	400	3.0	3.1	3.3	(1)	(1)	(1)
U.S. Information Agency	150	.2	.3	.5	.8	3.3	3.2
Other	500	1.3	1.7	.8	(1)	.9	.4
Total, research and development		8,754.0	9,618.0	11,475.9	536.8	625.9	889.4

[1] Less than $50,000.

ANNEX 4

SUMMARY INFORMATION CONCERNING THE DISTRIBUTION OF NATIONAL RESEARCH AND DEVELOPMENT FUNDS, ACTIVITIES AND PERSONNEL

The three tables below illustrate the growth of the total national expenditures for research and development, their distribution among basic types of performing institutions and types of functions, and the numbers of scientists and engineers involved. (Source: National Science Foundation.)

1. National research and development expenditures [1]

[Dollars in millions]

	Fiscal years					Percent of increase		
	1954	1955	1959	1960	1961	1954–61	1959–61	1960–61
By source of funds:								
Federal Government	$2,740	$3,070	$7,170	$8,290	$9,220	236	29	11
Industry	2,240	2,365	3,620	4,030	4,490	100	24	11
Universities and university research centers	130	140	190	200	210	62	11	5
Other not-for-profits	40	45	90	100	120	200	122	20
Total	5,150	5,620	11,070	12,620	14,040	173	27	11
By performer:								
Federal Government	970	950	1,730	1,830	2,060	112	19	13
Industry	3,630	4,070	8,300	9,550	10,500	189	27	10
Universities and university research centers	450	480	840	1,000	1,200	167	43	20
Other not-for-profits	100	120	200	240	280	180	40	17
Total	5,150	5,620	11,070	12,620	14,040	173	27	11

[1] Expenditures tabulated in this annex are based on reports to the NSF by performers of R. & D. work. Expenditures reported in annex 3 are taken from data within program and account structures used in the Federal Government. The 2 sources of data are not directly comparable.

2. Expenditures by functional area in fiscal year 1960 [1]

[Dollars in millions]

	Total R. & D.	Functional area			Percentage distribution		
		Basic	Applied	Development	Basic	Applied	Development
Federal Government	$1,830	$220	$460	$1,150	12	25	63
Industry	9,550	345	1,955	7,250	4	20	76
Universities and university research centers	1,000	550	330	170	50	33	17
Other not-for-profit organizations	240	85	105	50	35	44	21
Total	12,620	1,150	2,850	8,620	9	23	68

[1] Expenditures tabulated in this annex are based on reports to the NSF by performers of R. & D. work. Expenditures reported in annex 3 are taken from data within program and account structures used in the Federal Government. The 2 sources of data are not directly comparable.

3. Scientists and engineers in research and development

	Calendar years (numbers in thousands)			Percent of increase	
	1954	1958	1960	1954–60	1958–60
Federal Government	29.5	40.2	41.8	42	4
Private industry	164.1	239.5	286.2	74	20
Universities and university research centers	25.2	42.0	52.0	107	24
Other	4.4	5.4	7.0	59	30
Total	223.2	327.1	387.0	73	18

ANNEX 5

SALARIES AND RELATED BENEFITS AND TURNOVER OF PERSONNEL

This annex presents and analyzes certain of the data compiled from the questionnaires sent out by the Bureau of the Budget in connection with the review of contracting for research and development. (Annex 2 cites the organizations involved, describes the nature of the sample and some of the staff characteristics of the organizations.) Included are summary data on the salaries and related benefits provided by the 71 Government laboratories and other types of installations, universities, private businesses, and not-for-profit institutions responding to the questionnaires. The annex also presents summary data on the turnover of personnel experienced by those respondents.

1. Salaries

Salary data regarding the scientific and engineering personnel in establishments included in the study are presented in charts 1–4 in a manner to indicate the highest college degree held, the number of years since receipt of the bachelor degree, and the category of employing establishment (colleges and universities, contractors, and Government).

Separate salary tabulations are provided in schedule A for selected categories of top level executive, technical, and other management personnel in contractor establishments. In addition data are presented in narrative form covering a number of related salary and other employment benefits, including bonus, stock option, and deferred payment plans; life, health and accident insurance plans; annual, sick and other leave plans; retirement plans; and similar matters.

Although no detailed analyses of college and university salary data are presented because of the sparseness of data provided, it was possible to discern that base salaries paid by such institutions were the lowest of the three employer groups studies. However, employees of colleges and universities as a group undoubtedly have substantially higher total income than the data indicate, as a result of related earnings derived from lecturing, off-duty consulting, and book authorship.

The data indicate that, overall, related benefits provided by contractor and Government establishments are reasonably comparable, except that cash bonuses, stock options, and deferred payment plans, provided for top management and senior staff members by about one-third of the contractor establishments, have no counterpart in the Federal service.

Most significantly the data indicate the clear-cut advantage held by contractor over Government-operated establishments in terms of overall salary policies and levels. Contractor salaries consistently are higher than Federal salaries regardless of highest degree held and

period of time at which measured. Contractors offer higher average starting salaries, provide greater annual salary growth over a longer period of time, and consequently provide the average employee with a higher maximum salary expectancy. The difference in favor of the contractor is so consistent and so great that at any point during employment, the average contractor employee with only a bachelor degree can expect to receive a considerably higher salary than the average Federal employee with a doctor degree.

Basic salary data were obtained using the salary-maturity approach, in which salaries are related to the highest college degree held and the number of years since receipt of the bachelor degree. It is recognized that the salary-maturity approach does not permit consideration of variations in individual job responsibility. However, time and staff limitations precluded the use of the more valid job matching technique. It is emphasized that the salary data provided relate to base salaries only, and are exclusive of cash bonuses, stock options, or any other item of remuneration which might be received from the employing establishment.

Salary-maturity data were reported for a total of 50,635 employees, including 1,606 employed by educational institutions (colleges and universities), 16,547 employed by the Government directly, and 32,482 employed by contractors (business firms holding research and development or operational contracts with the Government). These totals do not include employees without degrees, and some executive level personnel not reported in this manner, both of which are included in totals presented in table 2, annex 2.

Charts 1–4 reflect salary progression for each of the degree-employer groups as reflected by the mean salary paid at each yearly interval following receipt of the bachelor degree.

All groupings of data indicate relatively consistent patterns of salary growth. The most active period of salary growth is that beginning immediately after receipt of the highest degree held, and ending at about the 20th year following receipt of the bachelor degree, although an occasional individual grouping may have a slightly longer or shorter growth period. After reaching peak levels at about the 20th year, salaries tend to level off.

Comparisons of Government and contractor salary data show that contractors typically pay higher initial salaries than the Government, provide significantly larger year-to-year salary increases, provide a generally longer period of salary growth, and as a result, offer a much higher maximum salary expectancy for the individual employee. This is consistently true regardless of the highest degree held.

(A) BACHELOR DEGREE EMPLOYEES

Employees with bachelor degrees start working at average salaries of approximately $5,954 per annum for the Government and $6,881, or $927 per year more for contractors. The average Government salary advances to $10,627 during the 13th year and $11,608 at the 20th year. Contractor salaries increase steadily through 20 years to $13,608; although a leveling off trend then appears, some salary growth continues beyond the 20th year. Contractor salaries continue rising gradually but steadily to a high of $15,367 at the 40th year, compared to average Federal salaries of $10,555 or $4,812 less, at the same point.

(B) MASTER DEGREE EMPLOYEES

Employees with master degrees, 2 years after receipt of the bachelor degree, receive average salaries of $8,534 from contractors but only, $6,674, or $1,860 less, from Government employment. Here too the most active growth period for Government scientists and engineers is shorter, 13 years compared to 17, and salaries startl eveling off at a lower rate, $11,033 compared to $14,995. Contractor salaries continue a gradual growth trend, reaching peaks of $15,733 and $15,945 at the 25th and 40th years. Salaries of Government employees continue to climb gradually to $12,545 at the 30th year, then drop to $11,873 at the 35th and $11,229 at the 40th year. Forty years after receipt of the bachelor degree these employees are paid $4,646 more by contractors than by the Government.

(C) PH. D. DEGREE EMPLOYEES

At the fifth year following receipt of the bachelor degree (the first year at which substantial salary data are available from both types of employers) scientists and engineers holding doctor degrees are paid average salaries of $11,564 by contractors and only $8,606 by the Government. This initial difference of $2,958 increases steadily, reaching $4,003 at the 20th year, $4,988 at the 25th year, and $5,550 at the 40th year (average salaries of $16,891, $18,342, and $19,188 respectively by contractors compared to $12,888, $13,354, and $13,638 at these points by the Government).

Chart 1

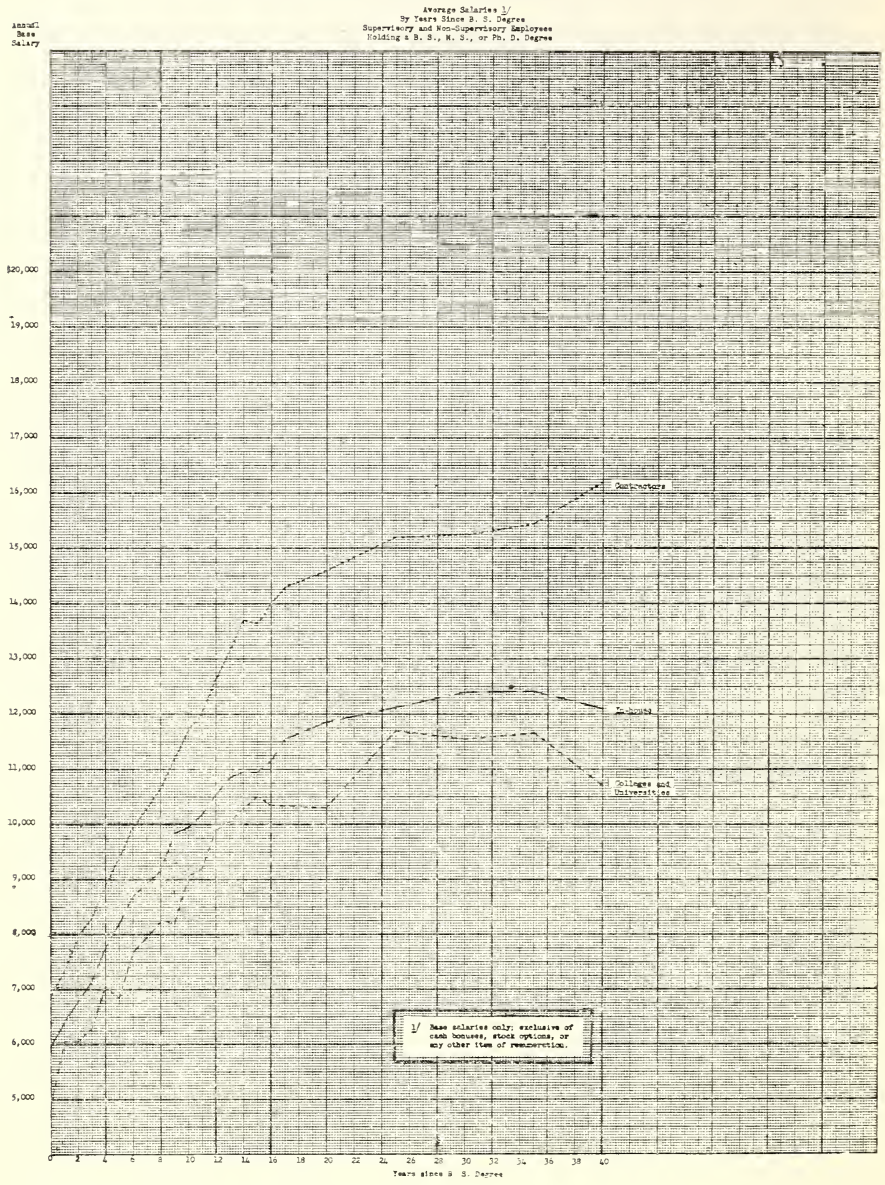

Average Salaries 1/
By Years Since B. S. Degree
Supervisory and Non-Supervisory Employees
Holding a B. S., M. S., or Ph. D. Degree
Annual Base Salary
$20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
Contractors
Industry
Colleges and Universities
1/ Base salaries only; exclusive of cash bonuses, stock options, or any other item of remuneration.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Years since B. S. Degree

CHART 2

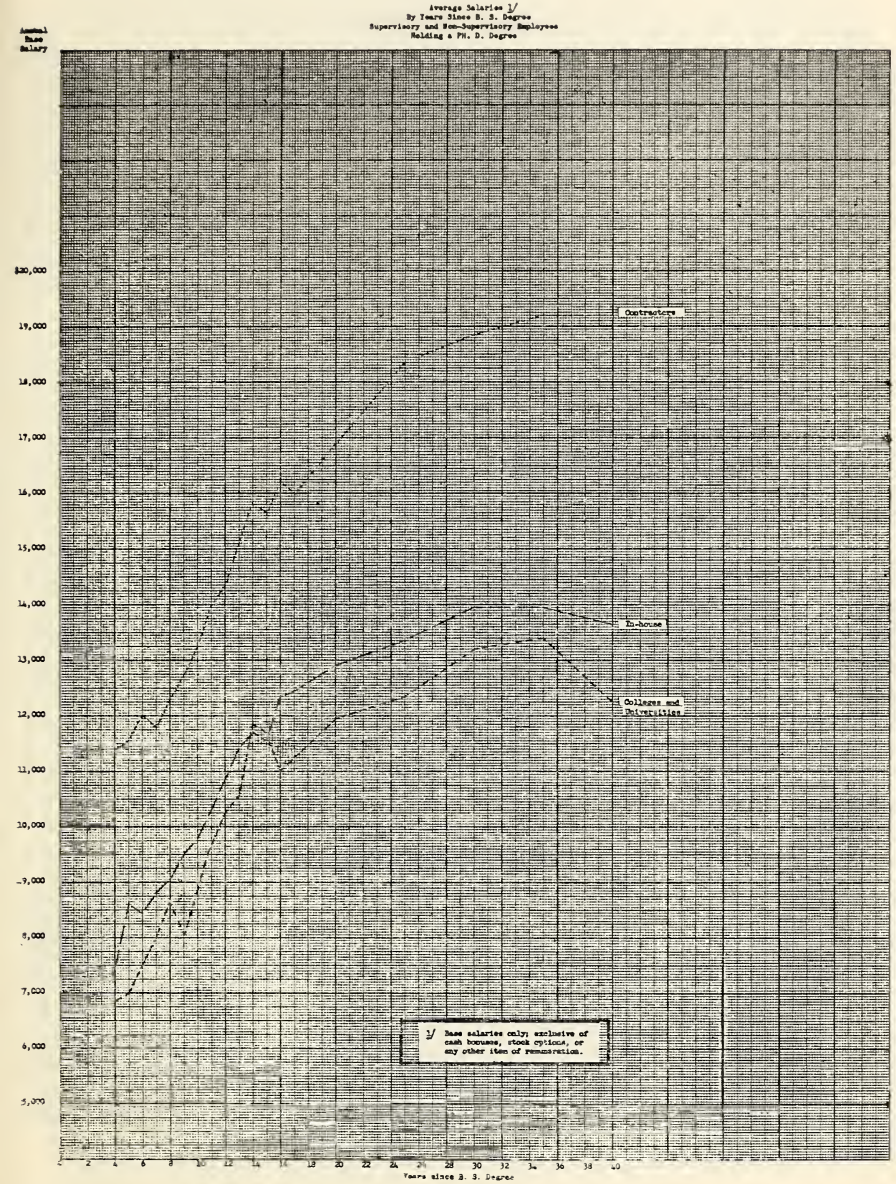

Average Salaries 1/
By Years Since B. S. Degree
Supervisory and Non-Supervisory Employees
Holding a Ph. D. Degree
Annual Base Salary
$20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
Contractors
In-house
Colleges and Universities
1/ Base salaries only; exclusive of cash bonuses, stock options, or any other item of remuneration.
Years since B. S. Degree

Chart 3

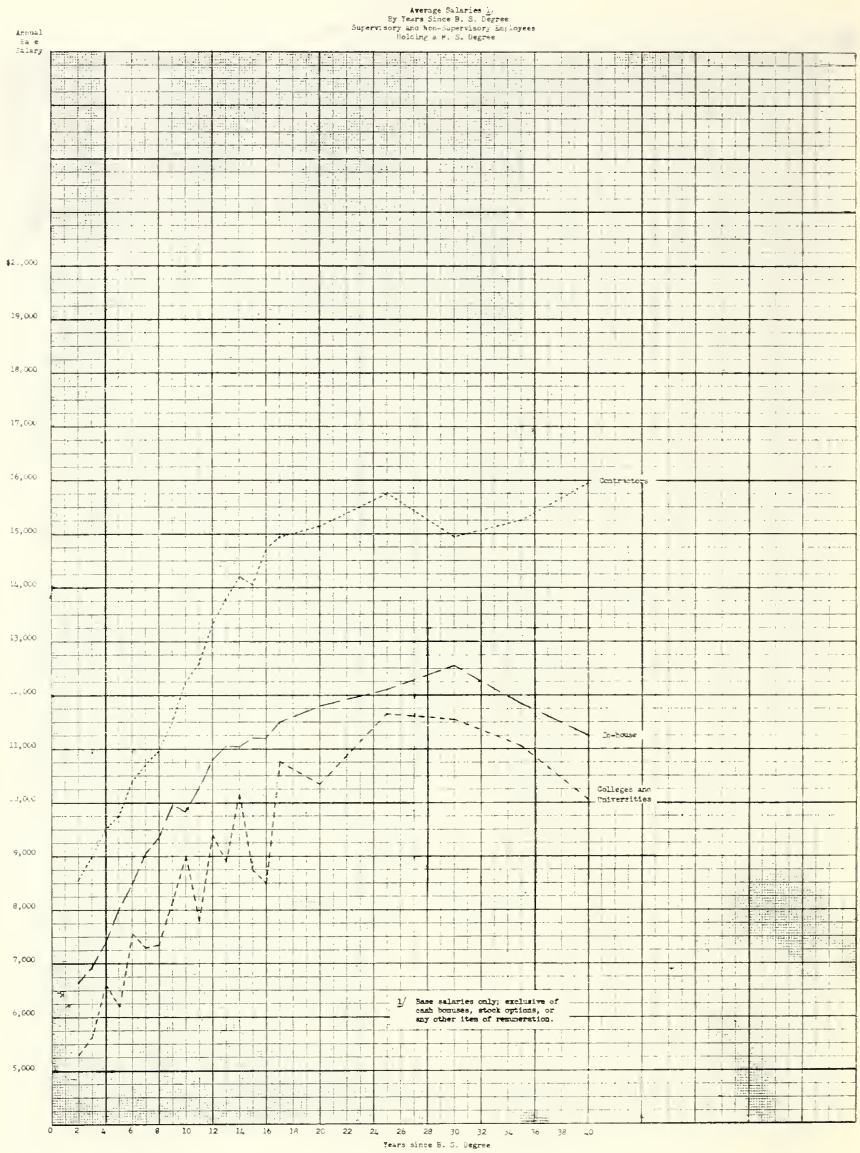
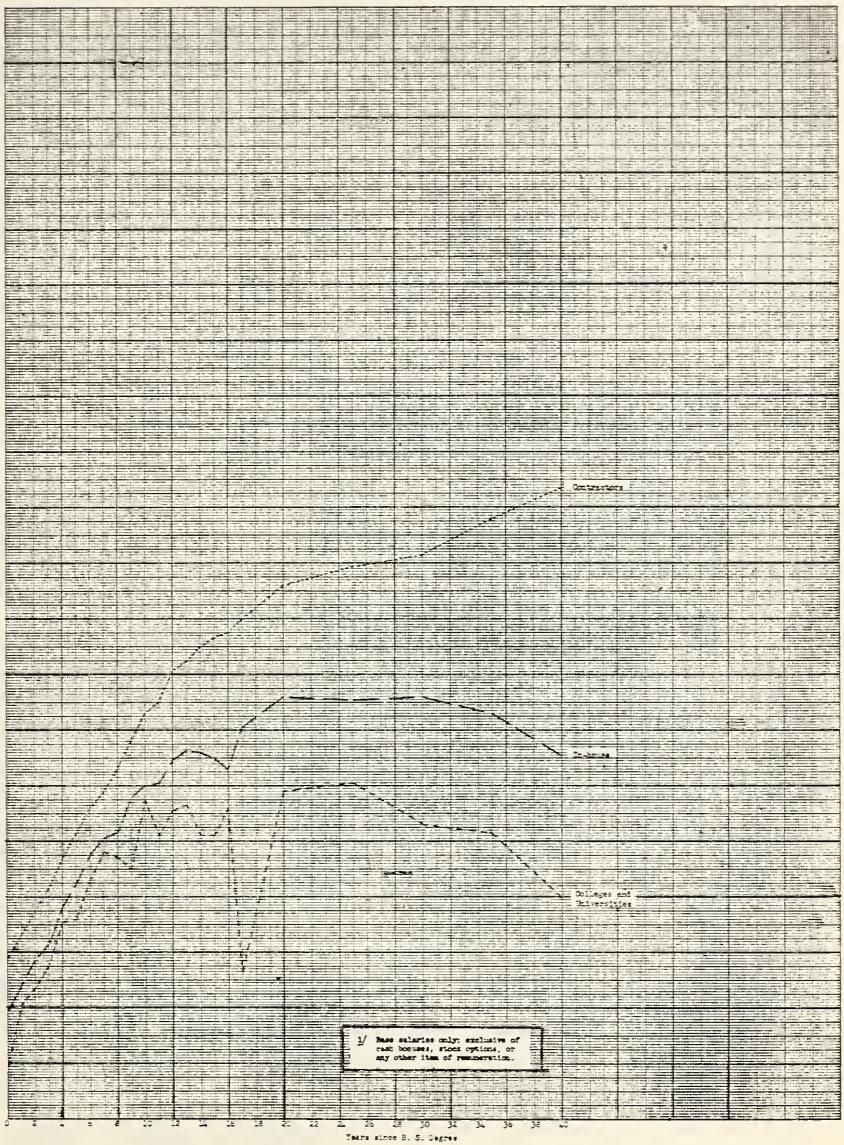

Average Salaries 1/
By Years Since B. S. Degree
Supervisory and Non-Supervisory Employees
Holding a M. S. Degree
Annual Base Salary
$20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
Contractors
In-house
Colleges and Universities
1/ Base salaries only; exclusive of cash bonuses, stock options, or any other item of remuneration.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Years since B. S. Degree

CHART 4


Average Salaries 1/
By Years Since B. S. Degree
Supervisory and Non-Supervisory Employees
Holding a B. S. Degree
Annual Base Salary
$20,000
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18,000
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6,000
5,000
Contractors
Industry
Colleges and Universities
1/ Base salaries only; exclusive of cash bonuses, stock options, or any other item of remuneration.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Years since B. S. Degree

SCHEDULE A.—*Distribution of selected contractor personnel (executives, technical directors, systems engineers, specialists, and other technical and management personnel)*

Annual base salary	All categories		Executives		Technical directors		Systems engineers		Specialists		Other technical and management personnel	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	582	100.0	178	30.6	268	46.0	87	14.9	32	5.5	17	2.9
$22,800 to $25,000	220	37.8	42	23.6	95	35.4	56	64.4	19	59.4	8	47.1
$25,000 to $30,000	226	38.8	63	35.4	124	46.3	28	32.2	5	15.6	6	35.3
$30,000 to $35,000	94	15.8	31	17.4	47	17.5	3	3.4	8	25.0	3	17.6
$35,000 to $40,000	14	2.4	12	6.7	2	.7	------	------	------	------	------	------
$40,000 to $45,000	17	2.9	17	9.6	------	------	------	------	------	------	------	------
$45,000 to $50,000	6	1.0	6	3.4	------	------	------	------	------	------	------	------
$50,000 to $60,000	3	.5	3	1.7	------	------	------	------	------	------	------	------
$60,000 and over	4	.7	4	2.2	------	------	------	------	------	------	------	------
Total	582	100.0	178	100.0	268	100.0	87	100.0	32	100.0	17	100.0

(D) INTERNAL SALARY RELATIONSHIPS—CONTRACTOR AND GOVERNMENT

Charted salary averages indicate that both Government and contractor establishments offer higher initial salaries to holders of each successively advanced degree. Contractor starting salaries average $6,881 for bachelors, $8,534 for masters (second year after receipt of bachelor degree), and $11,382 for doctors (fourth year). Corresponding initial Government salaries are $5,954, $6,674, and $7,500.

The study shows that contractors maintain these salary differentials throughout the 40-year period measured from receipt of the bachelor degree. The salary differentials, measured at the 5th, 25th, and 40th years, are $1,800, $2,609, and $3,243, for doctor over master, and $591, $1,806, and $578 for master over bachelor degrees.

Internal degree-salary relationships differ markedly from this pattern in Government establishments. Starting with the second year following receipt of the bachelor degree, through the sixth year, the average bachelor salary is higher than the master salary. Masters receive more than doctors during the 6th to 11th years. During the 6th to 10th year the average bachelor salary is higher than the average doctor salary. After the 11th year salary relationships are similar to those existing in contractor establishments, i. e., doctors are paid more than masters, and masters are paid more than bachelors. Average salaries for these three groups of in-house employees for the 5th through 11th years, plus the 25th and 40th year are as follows:

Year	Degree		
	Doctor of philosophy	Master of science	Bachelor of science
5	$8,606	$7,984	$8,245
6	8,454	8,486	8,774
7	8,781	9,065	9,030
8	9,051	9,338	9,155
9	9,502	9,938	9,818
10	9,803	9,874	9,984
11	10,306	10,316	10,045
25	13,354	12,098	11,572
40	13,638	11,229	10,555

Not only do the trend lines indicate that degree for degree the contractor employee can expect significant salary advantage over his Federal counterpart during all periods of employment, they also show that at each measured time interval through the 40th year, the contractor employee with bachelor degree can expect to earn a significantly higher salary than the Federal employee holding a doctor degree. The difference in favor of the contractor bachelor degree holder over the Government doctor degree holder is more than $500 in 17 of the 19 time periods measured and more than $1,000 in 10 of those years. The actual difference amounts to $1,478 at the 10th year, and to $1,729 at the 40th year.

(E) COMPARISON WITH OTHER STUDY DATA

General comparisons were made between salary maturity data developed by this study and similar data published in the "1961 National Survey of Professional Scientific Salaries" by the Los Alamos Scientific Laboratory of the University of California. Similar methods were used to conduct both surveys, which were completed within 4 months of each other. Both studies cover scientific and engineering personnel in research and development activities, only. Precise comparisons of the two survey results are prevented, however, by the considerable differences in the size of the surveys, and the number and type of firms covered by each. For example, this survey covered 35 contractor firms doing primarily research and development work for the Government. The total sample was 32,482. The LASL study covered research and development operations in 334 companies in about a dozen different industries, with a total sample of 96,186. Obviously the average firm in this study is much larger than its counterpart in the LASL study. Also, the Government contractor establishments, having research and development as their principal salable product, probably are inclined to pay higher salaries to research and development personnel than are firms (as in the LASL study) in which research and development typically is only a small part of a large complex of industrial operations.

Even after making allowances for the influence of these differences, the very significant conclusion stands out, that both studies show that the Government pays significantly lower salaries to its scientific research and development personnel than do private employers.

(F) PAY AS AN ADMINISTRATIVE PROBLEM

In responding to the questionnaire, officials of Government establishments consistently point to the salary situation as one of the most important administrative problems they must face. They cite such things as actual differences in salary structures, limitations on Public Law 513 positions, the need for more flexibility in fixing starting salaries and in granting merit increases, the insignificant pay distinctions between the research workers and their supervisors, and the relatively low maximum salary potential which is possible within existing salary structures. The National Bureau of Standards indicates that low pay is the most inhibiting factor in developing its manpower resources. It also cites the lack of availability of Public Law 313 billets and the inflexibility of the Federal salary system. The National Institutes of Health refers to an average salary of $22,600 disclosed by a salary

survey involving a selected group of leading medical schools and research institutions. Government laboratories cite case after case in which potentially qualified candidates, or those already employed, have been lost to industry at salary differentials of up to $5,000 or more. They indicate they are especially handicapped in recruiting candidates with Ph. D. degrees.

(G) PRACTICES IN GRANTING SALARY INCREASES WITHIN A RATE RANGE OR GRADE

None of the contractor establishments reported that periodic salary increases are granted automatically. Increases are awarded on an individual basis, primarily on employee performance, qualifications, and other merit factors. Considerable flexibility exists in the frequency and the amount of merit increases which may be awarded. Generally, merit increases and other pay adjustments are made as a result of semiannual or annual reviews. Except in special cases, employees may not receive more than one merit increase each year. Most plans limit the amount of the increase which may be granted to an employee. This amount ranges from 6 to 20 percent per year, although exceptions in especially meritorious cases may be granted. Most contractor establishments provide an annual budget for merit increases which may not be exceeded. Further controls may be applied, such as high level approval of individual increases, maturity on curves, and salary surveys. The average of increases awarded in 1961 to scientific and professional personnel ranged from 4 to 9 percent.

(H) PROMOTIONS FROM ONE PAY GRADE OR RANGE TO A HIGHER GRADE OR RANGE

Very little information on promotion practices was provided. Twenty contractor establishments reported that promotions from one grade or salary range to a higher grade or salary range was made, as vacancies occur, on the basis of job performance.

(I) FLEXIBILITY IN SETTING INITIAL SALARIES

Of the 29 contractor establishments reporting on their inhiring salary practices, only 3 require that new amployees in scientific and professional positions be hired at the minimum rate in the salary range for the grade or level of position. The other 26 have flexibility to set the initial salary at any rate within the range, subject only to certain administrative controls designed to preserve a reasonable consistency in the internal alinement of salaries. Some of the controls used are: (1) prior approval of individual salaries by top management officials or committees, (2) general comparability with prevailing rates as indicated by local and national salary surveys, and (3) maturity curves.

(J) WORKING HOURS

(1) Government establishments

Scientific and professional personnel are required to adhere strictly to the prescribed working hours in nine establishments. However, 22 establishments reported administrative flexibilities in working hours, particularly for higher grade professional personnel. Eight reported

specific provisions for the establishment of irregular tours of duty to permit personnel to attend daytime classes in pursuit of advanced college degrees. Fifteen establishments permit adjustments in working hours at the discretion of the individual or his supervisor, provided that this does not inconvenience the establishment or his project associates. Most establishments are open nights and weekends to accommodate scientists who wish to perform voluntary overtime.

(2) Contractor establishments

One contractor establishment reported a 37½-hour workweek; all others reported a standard 40-hour workweek.

Fifteen contractor establishments reported that no flexibilities are permitted in the workweek except that scientists and engineers may voluntarily work overtime.

Seventeen contractor establishments reported considerable flexibility in permitting adjustments in the workweek to attend college classes, to meet transportation problems, and to otherwise accommodate the needs of the individual scientist or engineer.

(3) Overtime pay practices

Of the 36 contractor establishments reporting on overtime pay practices, 15 pay no overtime to employees exempt from the Fair Labor Standards Act. The other 21 pay overtime compensation to exempt employees in one way or another. Some pay straight time; some pay straight time plus a flat dollar amount; some pay a sliding scale of lesser amounts as salary rates increase. Several mention ceilings above which no overtime compensation is paid, for example, $7,500, $10,167, $14,400, and even $16,800. Others limit the number of hours for which it may be paid. Ten of the contractor establishments appear to have practices more liberal, in some respects, than current Federal practice.

2. Related Benefits

The different contractor benefit plans vary considerably in detail. In view of this and also because of the limited information provided in the questionnaires, it is not possible to make exact comparisons between contractor and Federal benefits. However, several useful general comparisons may be made.

(a) bonus plans

Nine contractor establishments reported and described bonus plans, based on a variety of circumstances, such as extraordinary merit, length of service, comparative performance, contribution to success of organization, or profit distribution. Such payments are known by various titles, including bonus, incentive compensation, supplemental composition, and contingent compensation.

Distribution of such payments varies widely, from the broad base of one establishment which provides for all employees of record the week of December 15, to the narrow base in another establishment providing bonuses only to top executives exercising direct influence on the corporate business and profits.

The amount of bonus or similar payment to individual employees ranges from $10 on service for less than 3 months to awards of over

$1,000 for which installment payments are arranged. The dollar amounts distributed in fiscal year 1961, or the latest year reported, ranged from $18,250 to $2,900,000. Establishments did not report average amounts paid to eligible employees and executives, although in some cases the total number or payroll percentage of recipients was indicated, as shown in the following résumé.

Establishment	Groups eligible	Basis for payment	Amount
A	Divisional employees	Merit; not a sharing of profit	Calendar year 1961 $90,565 (0.5 of total divisional payroll).
B	All employees of record during week of Dec. 15.	Employees in accordance with length of service—$10 to 2 weeks' base pay. Management; 1 month's base salary. Department heads and key employees ⅔ of 1 month's base salary.	Fiscal 1961, $186,782.23.
C	Management employees (generally) but may include others who have made a substantial contribution to success of company.	Incentive compensation fund may not exceed 6 percent of gross profits. Relative participation rather than fixed amounts. 5 classes or grades in upper management. 3 classes or grades in lower management; based on performance in a forced distribution.	For entire company, established on basis of company earnings in 1960 and paid in 1961, $2,900,000.
D	Employees in top 4 salary grades plus employees on the executive payroll as of Oct. 1. 1960.	Yearend incentive compensation payment based on anticipated profits for calendar year 1960. Based on individual performance—maximum—not to exceed ½ annual base salary—minimum—not less than $500 to any employee.	Approximately 30.4 percent of eligible employees received awards amounting $537,150 in December 1960.
E	Top executives exercising direct bearing on the business and profits of the company. Selected by management incentive plan committee.	Rated on performance and contribution by committee to determine percent of annual salary for bonus. Corporate management determines percent requested amount to be funded, and recomputes individual payments accordingly.	Fiscal 1961 $799,317.69 (0.6446 percent of the total salaried payroll).
F	Eligible employees determined by the corporation's audit and compensation committee upon recommendations by division general managers, vice presidents, and group executives.	Bonus payment or supplemental compensation plan approved some years ago by stockholders and the Bureau of Internal Revenue.	For last fiscal year reported, supplemental compensation of $2,190,950 was awarded in varying amounts to 624 employees.
G	Executives, technical directors, and departmental managers whose annual salary is $9,000 or more.	Contingent compensation controlled by bylaws of company; gross dollars not to exceed 10 percent of net profit.	Fiscal 1961, 13 employees dollar amount, $18,250.
H	Higher level management executives and principal technical employees.	$1,000 awards paid promptly; over $1,000 beneficiary receives promptly $1,000 or 20 percent (whichever is greater) remainder in installments in last month of each succeeding fiscal year.	Fiscal 1961 total dollar amount paid to staff was $126,340.
I	Management personnel	Individual's performance—comparative performance among operating units of corporation.	Amount within laboratory fiscal year 1961, $315,280.

(B) STOCK OPTION PLANS

Twelve contractor establishments reported stock option plans.

In the main, contractors operating stock option plans offer such options to executives, key personnel, and senior level employees, or to employees who are holders of options for stock in a parent corporation, sometimes restricting the offers to those designated by a stock option committee, by whatever name known.

Limitations as to maximum purchases of shares are geared to yearly compensation, to specific numbers of shares (2,000, 20,000, 30,600, 35,000, for example), or left to the discretion or designation of the stock option committee.

Where reported, prices at which the optioned stocks may be purchased ranged from 85 to 100 percent of the fair market value at the time of granting the option, with a 95-percent figure occurring in two-thirds of the offers (six of nine) mentioned.

In no case documented does the contractor make a contribution to such purchases.

(C) DEFERRED PAYMENT PLANS

Deferred payment plans were reported by nine contractor establishments. Individuals eligible to participate in such plans are generally mentioned by rank or category. One plan applies only to the president, another only to the president and vice president, of the organizations. Inclusions of wider scope are mentioned as:

Participants in Teachers Insurance and Annuity Association and College Retirement Equities Fund retirement plan;

Senior executives and scientists;

Selected senior staff members;

Employees at the highest salary levels;

High level management executives and principal technical employees;

Key personnel.

Data about the sums involved in deferred payment plans are meager. The total amount devoted to this form of compensation in 1960 is mentioned by one establishment as $50,000, characterized as "modest compensation for performance in a given year," for selected staff members. In another establishment, deferred compensation of $5,000 per annum, for the president only, is paid into the corporate retirement plan administered by TIAA/CREF. In a third establishment, in case an award in a bonus plan is over $1,000, the amount above that figure is paid in deferred installments. Other deferred payments, where the amounts available are not described, take the following forms:

Annuity option for participants in TIAA/CREF;

Annuities purchasable, or agreements for forefeitable deferred compensation;

Offer to purchase stock on a deferred payment plan when stock is available;

Deferment of full amount of incentive compensation award;

Deferment of that portion of executive compensation award which is payable in capital stock of the company;

Deferment of a portion of base salary;

(For the last three, the accrued amount is payable on termination of employment, normally by retirement, in 10 (or other agreed upon number) annual installments.)

(D) LIFE INSURANCE PLANS

All contractors reported life insurance plans for their employees.

The plans are generally similar to the Federal employees life insurance program. Double indemnity for accidental death and dismemberment is included. However, the amount of life insurance available to the employees in most contractor establishments exceeds the amount available to Federal employees. The amount avilable to contractor employees ranges from an amount about equal to the annual salary up to three times the annual salary, the maximum amount available ranging up to $225,000.

Total cost of insurance ranges from 40 cents to 66 cents per month per $1,000 of insurance. Employee contributions range from none to all (60 cents per month per $1,000). Most employee contributions are one-half or less of the total cost. Most typically, the employee contributes 27½ cents per month per $1,000 and the contractor contributes an equal amount. This compares to the 54 cents per month per $1,000 employee contribution under the Federal employees life insurance program. (The Government's contribution is one-half the employee's contribution.)

Many of the plans are combined with other benefit plans such as health and medical plans weekly accident and sickness insurance, permanent and total disability benefits, etc.

Most of the contractors also provide, at no cost to the employee, from $20,000 to $100,000 in accident insurance when employees are traveling on official business.

(E) HEALTH AND MEDICAL PLANS

All contractors reported health and medical benefits plans for their employees. The plans include basic hospitalization and surgical benefits plans supplemented by major medical insurance. While the plans vary considerably in detail, they provide substantially the same protection available to Federal employees. In several cases, particularly in the plans offered by establishments connected with universities, benefits also include free examinations and diagnoses, and infirmary privileges. In a few cases, the health and medical plans are a part of a "package" program which includes life insurance, weekly accident and sickness insurance, etc.

In three plans, the contractor establishment does not contribute toward the cost of the health and medical plans. In four plans, the establishment pays all of the cost of the employee's own coverage, but none of the cost of coverage for the employee's family. In 32 plans, the establishment contributes toward the cost of coverage (from 50 percent to 85 percent of total cost) for both the employee and his family. In these 32 plans, the cost to the employee ranges from $2.42 per month to $10.85 per month. Under the Federal employees' health benefit program, employee contributions range from $1.71 per month to $21.60 per month, dependent upon the particular plan selected.

(F) RETIREMENT PLANS

A total of 44 retirement or pension plans are provided by the 39 establishments reporting on this item. (Five establishments offered two plans, i.e., one plan for academic staff and another plan for full-time research staff.)

Most of the plans are directly related to the old-age and survivors insurance program and are designed to supplement that program. Benefits from the combined programs appear to be generally comparable to those provided under the civil service retirement system.

Twelve of the 44 plans are financed completely by the contractor. In the other 32 plans, the contractor's contribution to the plan equals or exceeds the employee's contribution. Most frequently, the contractor pays two-thirds of the cost of the plan.

Employee contributions (including OASI contribution) range from 2 percent to 7½ percent of total basic compensation. Most frequently, the contribution is 3½ percent to 5 percent. At the present time, employees under the civil service retirement system contribute 6½ percent of their basic compensation.

(G) PAID LEAVE FOR VACATION PURPOSES

Fifty different vacation plans were reported by 39 contractor establishments. (Vacations granted by some contractors vary according to the organization level of the personnel, i.e., a different and more liberal plan may be provided for top research staff personnel than for other personnel.)

The amount of vacation granted varies from 2 to 4 weeks. Thirty of the plans are on a graduated basis dependent upon length of service. In 22 of these plans, 2 weeks are granted during the first 2 to 11 years' service (most frequently 2 weeks during the first 10 years of service). In 20 plans, 3 weeks are granted after 2 to 11 years' service. In 15 plans, 4 weeks are granted after 4 to 25 years' service (in most cases after 20 years). The most typical plan would allow 2 weeks' vacation during the first 10 years of service, 3 weeks after 10 years' service, and 4 weeks after 20 years' service. (In the Federal service, employees are entitled to 13 days' annual leave during their first 3 years of service, 20 days with 3 to 15 years' service, and 26 days after 15 years' service.)

Any unused vacation is usually paid for at termination. Vacation leave may be accumulated for use in the following year, if employees were precluded from taking it because of the pressure of work. The maximum amount which can be accumulated ranges from 14 to 60 days (most frequently from 20 to 40 days). With some exceptions, Federal employees may not accumulate more than 30 days' annual leave.

A few contractors require employees to use vacation leave for absences for personal reasons. However, in most cases, such absences are not charged to vacation leave as they are in the Fedreal service.

(H) LEAVE WITH PAY FOR PERSONAL BUSINESS

Leave with pay (and without charge to vacation leave) is authorized by 26 contractor establishments for absences from work to conduct

urgent personal business which cannot be conducted outside regular working hours. Many contractors allow 3 to 15 days per year for such purposes as: funerals, births, family illness, moving, religious holidays, civil defense or civic activities, voting, blood donations, and so forth. Most such leave is approved informally, on a case-by-case basis. In the Federal service, annual leave must be used for absences for personal reasons other than illness.

(I) SICK LEAVE WITH PAY

Sick leave ranging from 3 days per year to 30 days per year is granted by 20 contractor establishments. (The most frequent is 12 days per year.) Eleven of these establishments permit accumulations of sick leave ranging from 20 to 125 days. Nineteen of the establishments approve leave with pay for illness or accidental injury on an individual basis.

Extended leave with pay, beyond the sick leave to the employee's credit, may be approved on a case-by-case basis. A few establishments provide for extended sick leave at reduced pay ranging from 50 to 90 percent of full day.

In many cases, death in the immediate family may be charged to sick leave, differing from Federal Government practice.

In the Federal service, employees are granted 13 days' sick leave per year, with no limit on the accumulation of unused leave.

(J) HOLIDAYS WITH PAY

The number of holidays with pay allowed by contractor establishments ranges from 7 to 10 days per year (most frequently 7 or 8 days per year). Federal employees are given eight holidays per year.

(K) LEAVE WITH PAY FOR JURY DUTY OR REQUIRED ATTENDANCE AT COURT AS A WITNESS

Thirteen contractor establishments reported that leave with pay is specifically granted for jury duty or for other required court attendance. Other establishments grant such leave as "leave for personal business," approved on a case-by-case basis. Nine establishments reported that the employee's pay is reduced by the amount he receives in court fees. Federal employees are entitled to leave with pay for jury duty; any fees received are deducted from pay.

(L) MILITARY LEAVE WITH PAY

Ten contractor establishments reported that leave with pay, ranging from 5 to 30 days per year, is granted for military training. However, in several cases pay amounts only to the difference between military and civilian pay. Other contractor establishments grant such leave as "leave for personal business," approved on a case-by-case basis. Federal employees are allowed 15 days leave with pay each year for military training, with no deduction for any military pay received.

(M) TEACHING

(1) Government establishments

Off-duty teaching for compensation is permitted by 31 establishments if it does not interfere with regular work, and does not violate security and conflict-of-interest restrictions.

Two of the 31 establishments discourage such activities but 10 of them encourage their employees to accept off-duty teaching assignments. In some cases, establishments will rearrange working hours to permit daytime teaching.

Approval of, or reporting, teaching activity is usually required.

(2) Contractor establishments

Off-duty teaching for compensation is permitted by 29 contractor establishments if it does not interfere with work or involve conflict of interest. Only two of these establishments indicated that they encourage employees to engage in outside teaching activities.

Four other establishments do not permit, or strongly discourage any teaching activity.

Five establishments reported that employees were permitted to teach not to exceed one daytime course. In such cases, any fees are turned over to the company for disposition.

Most establishments require that prior approval for teaching be obtained.

(N) CONSULTING

(1) Government establishments

In 28 establishments off-duty consulting for compensation is permitted if it does not interfere with regular work and if it complies with security and conflict of interest requirements. Only two establishments reported that such activity is not permitted.

In most cases, employees must obtain approval to engage in consulting activities.

(2) Contractor establishments

Thirty establishments (including five universities) reported that off-duty consulting for compensation is permitted, when it does not interfere with regular work or involve conflict of interest. In most cases, specific approval is required.

Several reported that the amount of such consultation is limited. In the case of three universities, the limitation is the equivalent of 1 day per week.

Outside consultation was either prohibited or rarely permitted by nine of the establishments.

(O) LECTURE FEES

(1) Government establishments

None of the establishments reported any restrictions on acceptance of fees for lectures given on employees' own time, provided any regulations regarding conflict-of-interest and use of Government information are complied with.

(2) *Contractor establishments*

Eight establishments do not permit employees to accept fees for lectures. Twenty-two others permit employees to accept lecture fees if there is no conflict of interest and lectures are given outside working hours.

(P) BOOK ROYALTIES

(1) *Government establishments*

None of the establishments reported any restrictions on the acceptance of royalties for books produced on employee's own time provided there is no conflict of interest involved and material does not violate any regulations regarding the use of Government information.

(2) *Contractor establishments*

Twenty-one establishments reported no restrictions on receipt of royalties for books produced on employee's own time provided no conflict of interest is involved.

Nine establishments require that all rights to books produced by employees be assigned to the company. Royalties, in whole or in part, may be given to employee, in the discretion of the company.

(Q) PATENTS

(1) *Government establishments*

Under pertinent laws and regulations, uniform practices with respect to patents are applicable to all Federal employees. Generally, the Government is entitled to all domestic patent rights to inventions and discoveries developed during working hours, or if the Government contributed facilities, equipment, materials, funds, information, or the time of other employees on official duty. Also, the Government has option to all foreign patent rights for 6 months after filing application for patent. If the Government determines that it has no interest in an invention or discovery, or if it decides not to exercise its options, it may give the employee authority to acquire patent rights and market the invention. Federal employees are generally entitled to patent rights for inventions developed on their own time which are not related to their work.

Most Federal agencies utilize the Incentive Award Program to reward employees for patentable inventions. The amount of the award is based on the utility to the Government of the invention. Several agencies grant small awards, $25 to $75 for each patent filed for or obtained, and additional awards based on the value of the patent to the Government.

(2) *Contractor establishments*

Thirty-four establishments reported that they have formal agreements with their employees requiring that all patentable discoveries and inventions developed are to be assigned to the contractor. In most cases, employees are permitted to market their inventions if they are unrelated to the work of the company and if they are developed outside working hours.

For inventions covered by the patent agreements, the companies determine the share, if any, of the royalties to which the inventor will be entitled. In many cases, awards (from $50 to $100) for each patent filed are made.

One establishment offers patent award payments up to $5,000 when the inventor makes a major contribution to the company's progress.

(R) PUBLICATION IN THE OPEN LITERATURE

(1) Government establishments

Scientists and engineers of 27 establishments reporting on this item are encouraged to submit articles for publication in the open literature. Many of the establishments furnish editing, typing, and other assistance for this purpose. In several cases this is considered a normal part of the employee's work and is a factor in evaluating his performance. In a few cases, small cash awards are given to employees who have had significant articles published. In most cases, proposed articles must be submitted for prior agency approval.

(2) Contractor establishments

An identical number of contractor establishments, 27, reported that they encourage scientists and engineers to submit articles for publication in the open literature, provided no violations of security regulations are involved. In most cases prior approval of the articles is required. In many cases, editorial, typing, and other assistance is provided. One establishment reported that it gave an award of $50 to $100 for each article published.

Seven other establishments reported that they permit publication of articles by employees, but subject to a number of limitations.

(S) ATTENDANCE AT PROFESSIONAL MEETINGS

(1) Government establishments

Twenty-eight establishments pay travel expenses for attendance at meetings of professional and scientific societies. The criteria for payment of expenses vary by agency and establishment. Of these, 22 encourage attendance at such meetings and attempt to pay expenses for all trips to meetings directly related to the employee's work or to meetings in which the employee is a direct participant. In addition some of these establishments will pay (within the limits of funds available) the travel expenses of each professional and scientific employee to attend at least one national meeting of his choice each year. A more liberal policy is followed with respect to attendance at local meetings. The major limiting factor is the amount of travel funds available to the establishment for this purpose.

(2) Contractor establishments

Seventeen establishments authorize attendance, with travel expenses paid, at professional meetings usually only when the meeting is directly related to the work of the employee or when the employee is an active participant at the meeting. Four other establishments will pay expenses only when the employee is attending as the official representative of the establishment. Sixteen additional establishments encourage attendance at professional and scientific meetings and pay travel expenses for such meetings usually up to a limit of one meeting per year for each employee even though the employee is not an active participant and the meeting is not directly related to his work.

(T) TRAVEL ALLOWANCES AND EXPENSE ACCOUNTS

While most contractor establishments reported the allowance of actual expenses while in a travel status, or in some cases specified the payment of per diem (chiefly between $12 and $16 a day) in lieu of actual expenses, a few indicated they considered such allowances in the nature of normal procedure rather than an employee benefit.

"Reasonable actual expenses" usually covered this item, three establishments mentioning $15 and one $18 as ceilings. Per diem rates in lieu of actual expenses were stated variously as "Government-approved rates;" $12, $15, sometimes according to place of travel; scales of $12, $14, and $15 according to salary status of employee traveling (e.g., under $10,000 a year, $10,000 a year and over, and officers, respectively); $16 to members of laboratory staff; $16 all, employees, $20, division and facilities chiefs; $16 in the United States, and State Department or Bureau of the Budget scales outside; and various sums as per diem ($8 to $13) in addition to travel expenses in three instances. Mileage for automobiles where mentioned was most frequently stated as allowable at 8 cents a mile; one range 7 to 10 cents; one at 8.5 cents; and two at 10 cents. Car rental was mentioned in two cases. (Federal employees are allowed up to $16 per diem and 10 cents a mile for use of automobiles.)

Four contractor establishments detailed provisions for allowing moving expenses on transfer or new hires. On transfer, one establishment assumes responsibility for all phases of relocation, including an additional month's pay to cover unforeseen contingencies. Others allow expenses and/or per diem for the employee and his dependents.

(U) SAVINGS PLANS

Credit Union availability and payroll deductions for purchase of U.S. savings bonds were most often the only savings arrangements reported by contractor establishments. However, two establishments offer plans in which the organization participates. One such plan requires 1-year service; maximum contribution of 7½ percent of salary per month (maximum $83). The company adds 10, 20, or 30 percent of amount contributed by the employee for 1, 2, or 3 and more years of service, respectively. Participant with 3 or more years of service may elect to have all moneys held as Government bonds, company stock, or cash, or a combination of these three. In the second plan, employees are eligible for participation in the company thrift plan, which permits a monthly contribution by the employee of up to 5 percent of his monthly salary plus an additional 1 percent for each 5 years of service by the employees. The company contributes 50 cents for each $1 contributed by the employee. The proceeds are used to purchase U.S. Government bonds and/or company stock at the election of the employee.

(V) MISCELLANEOUS BENEFITS

(1) Severance pay is provided by one contractor establishment. Staff personnel receive not to exceed 3 months pay, nonstaff receive not to exceed 8 weeks pay.

(2) A sabbatic pay plan is operated by one contractor establishment in which all persons exempt from the Fair Labor Standards

Act participate, after they have been with the establishment for 1 year. The plan provides that for each day of vacation accumulated after 1 year's service, the employee will accrue an amount equal to 3 percent of his monthly salary, payable at the time he takes his vacation. The sabbatic pay for vacation is in addition to regular salary paid during vacation. There are only two circumstances in which sabbatic pay may be received: If vacation is actually taken, or in case of termination.

(3) A hardship allowance of 10 percent of base salary is offered by one contractor establishment to employees permanently assigned at six designated work locations in the United States and Canada. This is to compensate for unfavorable circumstances such as weather, isolation lack of educational facilities, etc., and to reduce cost of staffing these locations by eliminating so far as possible, voluntary terminations and the ensuing cost of replacement. At some oversea locations, employees of this establishment receive hardship allowances based on U.S. State Department allowances for foreign service.

(4) A discount fare privilege of 90 percent is offered by one contractor establishment to employees and their dependents for vacation travel over the air routes of the system it operates.

(5) Sloan fellowships (1 year's study at MIT) are offered to two employees annually by one contractor establishment. These employees receive regular salary plus relocation and moving expense.

(6) Other: One contractor establishment provides top staff members $400 per month in the event of total and permanent disability. There is an offset against this benefit received from either workmen's compensation or the disability portion of the social security law. The same establishment provides a grant of $2,000 per year per child for those members of the president's staff who have sons or daughters enrolled in an accredited college or university (currently 12 students). Award of this grant is subject to the approval of the president of the organization.

3. Turnover

The universities covered in the survey provided only a limited amount of information on turnover of scientific and engineering personnel. Information on Government-military personnel was primarily concerned with intraservice movement below the $12,000 salary level. Therefore, the principal comparisons made below, on hires and separations, are between Government-civilian personnel and nonuniversity contractor personnel. Data relate to fiscal year 1961.

Few respondents provided data about increases in salaries resulting from change of employers, most stating that they did not know. For this reason, such data are not presented or analyzed here.

(a) hires

It is apparent that the contractors fill a much larger percentage of their jobs at intermediate and higher salary levels than does the Government. The contractors furnishing data hired 75 percent of their new employees under $12,000, as compared to 95 percent for the Government activities surveyed. The contractors hired 8 percent of their new employees above $15,000, as compared to less than 1 percent for the Government.

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The contractor's competitive advantage over the Government in hiring and retaining people at upper salary levels is indicated by the following comparison:

	Government hires from industry	Contractor hires from Government
Under $12,000	501	93
$12,000 to $15,000	30	32
$15,000 to $20,000	2	19

The absolute numbers are not, of course, significant in themselves, but the relationships seem to be. The contractors seem to be able to hire personnel away from the Government with equal success at all salary levels.

A comparison of separations by salary brackets also reveals certain significant differences:

Salary	Separations from Government to industry	
	Number of separations to industry	Percent of all separations at salary level
Under $12,000	297	21.6
$12,000 to $15,000	46	31.7
$15,001 to $20,000	12	27.3
Over $20,000	0	0

Salary	Separations from contractors to Government	
	Number of separations to Government	Percent of all separations at salary level
Under $12,000	66	6.0
$12,000 to $15,000	7	2.4
$15,000 to $20,000	7	4.4
Over $20,000	1	2.3

ANNEX 6

ANNOTATED BIBLIOGRAPHY ON FEDERAL CONTRACTING-OUT OF RESEARCH AND DEVELOPMENT

INTRODUCTION

The purpose of this bibliography is to identify significant documents, studies, reports, and comments which deal with the contracting out of Federal research and development programs to private institutions and enterprises.

No attempt has been made to cover all aspects of the subject. The intention is rather to select from the voluminous literature, published primarily since 1957, those materials which describe and appraise Federal organization and procedures for the conduct of research and development, both in direct Federal operations and by contract, pointing up criticisms of Federal practice and the problems and questions growing out of Federal experience in this area.

Citations to revelant public laws, departmental regulations, and Government-wide directives have not been listed. Texts of the more important of these may be found in numerous congressional hearings cited in this bibliography.

BOOKS, DOCUMENTS, AND MAGAZINES

Cherington, Paul W. and others. Organization and R. & D. decision-making within a Government department. (In Conference on the Economic and Social Factors Determining the Rate and Direction of Inventive Activity, 1960.) [Papers at a conference held under the auspices of the Universities-National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Council. New York, National Bureau of Economic Research, 1960] 29 pp.

Considers the relation between organization and R. & D. decision-making within a Government agency and draws some comparisons between the handling of R. & D. questions and problems in Government and in commercial organizations. Of particular interest are the sections dealing with the role of contractors and other forces influencing policy decisions (p. 16+), Noting that contractors "are perhaps the most important source of new weapons ideas" the writers point out that occasionally "advocacy becomes mixed with education in unwholesome proportions. Particularly troublesome are the unrealistic cost and time estimates submitted to 'sell' a company's proposals."

Corson, John J. Partners in the space age. (In Management Review, September 1959, v. 48, pp. 9–14+.)

Enumerates four developments in the space age that necessitate change in Government contracting policies and procedures and five requirements necessary to attain a balance between public and private business in the next decade.

DuBridge, L. A. Science and government. (In Chemical and Engineering News, Apr. 6, 1953, v. 31, pp. 1384–1390.)

The President of the California Institute of Technology says that "the most successful laboratories for turning out new ideas, new equipment, and new techniques for the military services are those operated under 'management contracts'—Government-owned laboratories under private management * * *. They have the advantage of private, civilian, non-civil-service management. And yet, being Government-owned, they can be kept in close touch with the practical problems of the sponsoring agency. * * *"

Recommends that the Department of Defense "begin at once to find ways and means whereby any new research facility, and as many as possible of the existing ones, may be transferred from military direction to the private management contracts. * * * I make this proposal because I think the Government is not getting its money's worth out of many existing military laboratories. Military organization, military customs, practices and rules, military traditions are all made for fighting and not for research. * * * Let's face the fact: a civilian scientist, as a scientist, just doesn't care to take his orders from a colonel. * * *"

Government Employees Council, AFL–CIO. Presentation of the Government Employees Council, AFL–CIO, to the executive branch of the U.S. Government in reference to the Council's opposition to Bureau of Budget Bulletin 60–2. Washington, D.C. 1961. 13 pp.

The Council is "gravely concerned over the growing practice in the Federal service, to contract to private interests, certain governmental services and functions that have historically been performed by civil service employees. This contract practice has increased over the past 8 years, and has been stepped up particularly as a result of the previous administration's policy required in Bureau of Budget Bulletin 60–2, dated September 21, 1959.

"This policy has led to, and caused, the discharge of thousands of career civil service employees before they have become eligible for retirement, and at an age where industry and other governmental agencies are unwilling to employ their services. The policy has caused the waste of valuable skills and the loss of the effective utilization of hundreds of millions of dollars invested in plant facilities and tools. It has caused thousands of families, and hundreds of local communities, to suffer adverse economic adjustment and hardships. It has also fostered and promoted higher defense costs to the taxpayer, and has been responsible for the adequacy, and quality, of our country's defense posture to be vested in the profit motivated segment of our economy, instead of under the control of the Congress and the administration, as required by our Constitution."

Harvard and the Federal Government; a report to the faculties and governing board of Harvard University [Cambridge, Harvard University, 1961]. 36 pp.

"Harvard is by no means unique in its new relationship with Government. At least 80 percent of the institutions of higher education in the United States now receive Federal funds, and Harvard is one of those heavily involved in Federal programs.

"Government funds tend to concentrate in the relatively few institutions with strong graduate and professional programs in the natural sciences because of the heavy national emphasis on research. A recent study of Federal expenditures for research in 287 institutions shows that 5 institutions received 57 percent of the total, while 20 institutions received 79 percent and 66 received 92 percent.

"By 1960 Harvard was participating in at least 34 categories of programs managed by two score Federal agencies, under the general oversight of a dozen congressional committees.

"The decentralized nature of Federal research programs may help the university protect itself against deliberate encroachment, but it makes it all the more difficult to preserve the proper balance * * * among various schools and departments, or within each of them between research and teaching.

"Federal grants for research and for construction have brought great benefits to Harvard yet there is a danger that the total program of the university could be affected by the extent that the unreimbursed costs and matching funds involved in such grants use up the precious unrestricted funds that would be available for other purposes. The three greatest threats posed by Federal aid are likely to be in the balance among the several fields of learning; in the balancing between teaching and research; and in the balance within the faculty between those with and those without tenure appointments.

"University and Government people alike have been slow to realize the significance of their new relationship. The Government now calls on the universities for achievements that depend on the highest qualities of creativity, but sometimes through purchasing procedures that could destroy the environment in which such qualities flourish. * * * Research can be carried on effectively in the long run only if a university maintains its overhead in an intellectual and academic, as well as an administrative, sense. * * * It is not a question of asking the Government for more money, but, rather, of asking it to give its funds with a proper regard for the total function of the university."

Heyman, Victor K. Government by contract: boon or boner? (In Public administration Review, spring 1961, v. 21, pp. 59–64.)

Concerned with the problems of control, economy, and benefits obtained by contracting with private institutions for services of an administrative, managerial, or scientific nature.

Enumerates the three major types of research and development contracts, giving examples of various types used by the military. States that "it is clear that the military has contracted for a wide range of functions which give the contractors tremendous power."

Defines contracting out as a "system that allows the Government to farm out a complete range of administrative and executive responsibilities accompanied by money, authority, and responsibility."

States that the problems arising from this system are as follows: (1) the Government will never be able to attain the knowledge and experience to perform its assigned functions with civil service and military personnel if it contracts for them every time they are needed; (2) the incentives to efficiency in most of these contracting operations are quite small, and in some cases negative; (3) the simple dependence of the Government, particularly the military, on contractors may be most undesirable; (4) the problem of salaries as function after function is contracted, the bidding price of good personnel goes up and the Government finds itself unable to hire and keep good men at civil service salaries.

Hitch, Charles and Roland N. McKean. Military research and development. (In their The economics of defense in the nuclear age. Cambridge, Harvard University Press, 1960, pp. 243–265.)

Defines the varieties of military research and development, enumerates some of the problems and "common pitfalls" and discusses proposals for reorganizing research and development.

The demand for strong central direction and coordination, review of programs and projects, elimination of competition, and the weeding out of duplicating projects are, according to the authors, "based on a fundamental misunderstanding of the nature of research and development. They treat as certain what is highly uncertain. They try to strengthen control at the top when what is needed is initiative and spontaneity at the bottom. They try to suppress competition and diversification because particular duplications are obviously wasteful from the vantage point of hindsight, apparently unaware that duplication is a rational necessity when we are confronted with uncertainty and that competition is our best protection against bureaucratic inertia."

The real and challenging problems in research and development are listed as: (1) How can we effectively decentralize? (2) How can we make good use of interservice and interagency competition while curbing its undesirable features? (3) How can we judge and choose contractors and laboratories? and (4) How should research and development be planned?

Katzenbach, Edward L. Ideas: a new defense industry. (In Reporter, Mar. 2, 1961, v. 24, pp. 17–21.)

Explains that the Government has established its own corporations independent of the civil service and therefore "contracted advice has become a new instrument of Government in our time." Describes these corporations and their influence.

Kidd, Charles Vincent. American universities and Federal research. Foreword by Paul E. Klopsteg. Cambridge, Mass., Belknap Press, 1959. 272 pp.

"The central thesis of this book is that large-scale Federal financing of research has set in motion irreversible forces that are affecting the nature of universities, altering their capacity to teach, changing their financial status, modifying the character of parts of the Federal administrative structure, establishing new political relations, and changing the way research itself is organized. I believe that the wisdom with which these forces are guided and controlled by the universities and by the Federal Government will have a major influence not only on the capacity of this Nation to defend itself, but on the economic growth of the Nation and the preservation of the essential values that underlie our society."

Of particular note are the chapters on research goals of Federal agencies (p. 1), Federal research funds (p. 39), and university participation in Federal decision (p. 189).

Livingston, J. Sterling. Weapon system contracting. (In Harvard Business Review, July–August 1959, v. 37, pp. 83–92.)

Considers the problem confronting the military in deciding how much authority they can delegate to private contractors without losing control over the development of their weapon systems, and also without abdicating their responsibility for the proper expenditure of public funds.

Believes that three methods of weapon system contracting will be used for some time to come: (1) The systems engineer and associate prime contractors method; (2) the system prime and associate prime contractors method; (3) the team contractor method.

Concludes that "as weapon manufacturers develop stronger systems engineering and managment staffs, the military services are likely to make greater use of system prime contractors for both systems integration and management. At the same time, the services can be expected to develop their own weapon systems engineering and management capabilities, to improve their decision-making processes, and to exercise more effective control over system prime and associate prime contractors."

Management of research, development, test and evaluation programs: U.S. Air Force. A study made by representatives of Bureau of the Budget, General Accounting Office, Department of the Air Force, Office of the Assistant Secretary of Defense (Comptroller). [Washington] 1960. 249 pp.

The study group summarizes its findings on organization for research and development management in these words: "The centralized organization for research and development (sec. III) represented by the Air Research and Development Command is unique in the Department of Defense. The organization structure lends itself to the development and application of uniform policies and procedures for program administration. The excellent system of program documentation and reporting, likewise, has been facilitated by the existence of a single centralized channel for management and administration." For a detailed analysis of the organization see pages 14–53.

Concerning contract versus in-house research the report states: "The Air Force accomplishes most of its research and development under contracts with universities, private scientific laboratories, and industry. Although a certain amount of research and development is performed in the ARDC centers and laboratories, the major in-house technical effort involves the testing and evaluation of contractor-developed military 'hardware.' From a financial management standpoint there is almost a complete sepa-

ration of the contract program and the in-house program. Everything accomplished in the contract program is planned, programed, budgeted, accounted and reported for in terms of individual research and development tasks, projects and systems, whereas the in-house R. & D. program, though planned and programed on a similar basis, is budgeted and accounted for on the basis of specific functions and organizations."

Miller, Arthur S. Administration by contract: a new concern for the administrative lawyer. (In New York University law review, May 1961, v. 36, pp. 957–990.)

Considers in detail "the closer relationship between Government and business and other private enterprises, carried out through the means of contract, the net result of which is the accomplishment of a number of governmental activities by private endeavor." Discusses the nature and extent of federalism by contract as well as its benefits and problems. Concludes that:

"1. The distinction between public and private law, already becoming an anachronism, will be further erased.

"2. Federal contracts are likely to become a part of public law, with all of the implications of such a development. For example, the illogical distinction between proprietary and governmental functions will be supplanted, should that occur. A new category of 'administrative contracts' may be recognized.

"3. Since the contractual system represents a partial joinder of political and economic power, the operation of Galbraith's 'concept of countervailing power' is being unbalanced or diminished. To some, this portends the likelihood of despotism.

"4. Recognition of the governmental character of contracting-out may speed the trend some perceive, and others argue for, toward the application of the constitutional concept of due process of law to the large business corporation.

"5. A further diminution in relative importance of both the Congress and the judiciary is likely to take place. The 'Administrative State' (Pound's 'executive hegemony') is already a reality, one in which executive decisions overshadow in importance the legislative and the judicial.

"6. A concept of cooperation will increasingly supplant the concept of competition which for so long dominated social and political thinking. Within the business community this development is already clearly evident; witness, for example, the demands for fair-trade laws, for the outlawing of 'unfair' competition, the administered-price system, and the growing recognition that a community of interest exists among the components of those huge private collectivities, the corporations * * * ."

National Research Council. Committee on Scope and Conduct of Materials Research. More effective organization and administration of materials research and development for national security; a report, Washington, National Academy of Sciences-National Research Council. 1960. 30 pp.

The Committee recommends the following Government incentives to stimulate research and development on new and improved materials for national security purposes:

"(*a*) *Contract Policy.*—Contracts with broadly defined objectives should be made, and detailed and time-consuming reporting and accounting procedures should be minimized. Adequate funding should be made available to sponsoring agencies in order to permit the placing of appropriate research and development contracts for periods of at least 3 and preferably 5 years.

"(*b*) *Patent Policy.*—In view of the differing policies of various agencies, a uniform patent policy should be developed for research and development work affecting materials following the present Department of Defense policy of allowing the contractor to retain commercial rights to any invention.

"(*c*) *'Know-How'.*—In order to make it practicable for industrial concerns with long experience to participate effectively in Government materials programs, provision should be made for limiting the extent to which 'know-how' acquired over a long period of time with private funds has to be released under a later Government contract."

National Research Council. Special Advisory Committee on the Role of the Department of Commerce in Science and Technology. The role of the Department of Commerce in science and technology; a report to the Secretary of Commerce [Washington, National Academy of Sciences-National Research Council, 1960]. 158 pp.

In this evaluation of the scientific research functions and operations of the Department of Commerce seven areas have been studied. These are: the National Bureau of Standards, the Weather Bureau, Coast and Geodetic Survey, Bureau of Public Roads, Office of Technical Services, Patent Office and Maritime Administration. Concludes that enlarged programs in science and technology are needed, and notes that inadequacies of present space and facilities are effective barriers to attracting new staff of the quality required. Suggests organizational changes and higher rates of compensation.

Price, Don K. and others. Current trends in science policy in the United States. (In Impact of science on society, v. 10, 1960, No. 3, pp. 187–213.)

The section devoted to problems in national science policy (pp. 194–202) considers contracts and grants, Government-university relationships, and Government-business relationships. An excellent bibliography accompanies the article.

Price Don K. Government and science, their dynamic relation in American democracy. New York, New York University Press, 1954. 203 pp.

In the chapter, "Federalism by Contract," (pages 65–94, the author notes that "the United States has improvised a new kind of federalism for the conduct of research. This is based on at least five types of relationships with private institutions." These he describes in detail and considers the implications of these new relationships.

"The contractual system has certainly given the Government, and particularly the military departments, great advantages of flexibility, and it has enabled them to make use of managerial talent that under present conditions cannot be found in adequate quantity in Government agencies. But this very advantage suggests the major weakness of the system: A government that cannot provide adequate administrators for the comparatively minor operating subdivisions of its program is bound to have difficulty in tying those pieces together into a general program that makes sense. It is proper enough to insist that each private institution ought to be given latitude in a research or development contract and not be bound by unnecessary specifications or requirements. But in a broad sense the program must be based on a coherent system of governmental requirements and public policy, or there is no justification in supporting it with public funds. The basic question is whether the Government has an adequate system of top management and enough foresight and expertise in preparing its advance plans to unify the vast scientific program into a coherent whole" (p. 92).

Ravitz, Harry I. Research and development procurement by the armed services. (In George Washington Law Review, January 1957, v. 25, pp. 240–255.)

"Outlines generally some of the more significant aspects of the field of research and development procurement by the three military departments, particularly those aspects which set it somewhat apart from other types of procurement." Notes the growing tendency "in the armed services for negotiations, preparation and administration of research and development contracts to be handled by personnel and organizations devoted primarily to this type of activity."

Research: leave how much to Uncle Sam? (In Business Week, Dec. 23, 1961, pp. 52–57.)

"The Government needs basic research to support its many advanced projects. Universities can't be employed to do all the necessary basic

studies the Government needs. Therefore, it stands to reason that industry should be called to do more and more of this kind of work. From the look of things, it shouldn't be long before everyone has as much Government-sponsored work as he wants—or can absorb."

Research and development procurement. (In Federal Bar Journal, July–September 1957, v. 17, pp. 179–327; October–December 1957, v. 17, pp. 329–474.)

Of particular note in these two issues devoted to research and development procurement are the articles by James T. Ramey and John A. Erlewine, "Introduction to the Concept of the Administrative Contract in Government Sponsored Research and Development," page 354, and John C.. Honey on "Federal Government Organization and Programs for Research and Development—an Overview," page 215.

Rivlin, Alice M. Federal support of research in universities. (In her Role of the Federal Government in financing higher education. Washington, The Brookings Institution, 1961, pp. 24–56.)

Reviews briefly the broad range of subjects covered by federally sponsored university research and discusses the impact of these programs on the colleges and universities. Notes that, "One persistent criticism of the Federal research program * * * is that it has been primarily project oriented. The Government has a long tradition of financing specific research projects, rather than giving block grants to be used at the discretion of the college or university doing the research. It has been alleged that the project system transfers control of the directions which inquiries should take from the institutions to the Government agency which approves and disapproves projects. Also, it is felt that the project system tends to favor areas in which the research to be done can easily be divided into neat packages—at the expense of newer areas in which specific projects may be hard to define." Other criticisms center around the computation of overhead costs and the use of funds for compensation of research work by faculty members.

Rovere, Richard H. Letter from Washington. (In New Yorker, Feb. 27, 1960, v. 36, p. 112+.)

Points out that "if restraints of the kind now imposed on the research organizations holding contracts with the Military Establishment are widely imposed and accepted, then the Government will lose the services of some gifted authorities and public opinion will be impoverished by the loss of many voices that might enrich it."

Emphasizes that the "principal value of independent organizations is, plainly, their independence." Points out the danger of their being "subjected to mounting political pressures."

Tybout, Richard A. Government contracting in atomic energy. Ann Arbor, University of Michigan Press [1956]. 226 pp.

An analytical study of the contractual arrangements between the Government and private contractors which have been adopted in the atomic energy industry. Examines the characteristics of fixed-price, variable-price, and cost-plus-fixed-fee contracts; discusses conditions under which each is used most effectively and their respective limitations.

"The full acceptance of uncertainty by the Government is found in cost-plus-fixed-fee contracts, which are the most important of the cost-reimbursement contracts. As their name implies [such contracts] provide that all expenses properly charged to the service of operation are to be paid by the Government, almost invariably in atomic energy contracting from working capital advanced by the Government (p. 51).

"Differences among cost-reimbursement contracts are due to differences in the fees which they provide. Academic and nonprofit institutions customarily receive no fees for cost-reimbursement work. * * * In contrast, business firms operating under cost-reimbursement contracts generally receive a fee which is compensation over and above reimbursement for all costs incurred * * *. Finally, there is the time-and-materials contract, which provides for reimbursement by adding to the direct labor and materials cost a factor which is intended to cover corresponding overhead cost plus a profit (p. 51).

"Cost-plus-fixed-fee contracts are the backbone of the atomic energy contractor system. They account for 80 percent by value of all atomic energy contracts * * *" (p. 63).

Miltary necessity has led to the adoption of cost-plus-fixed-fee contracts for the following reasons: (1) Unfamiliar production problems "which introduce risks into plant operations to the extent that nothing short of Government ownership and cost reimbursement provide adequate protection for the contractor;" (2) changing "military demands created by the armaments race, advancing military techniques, and changing strategic and tactical considerations * * *.

"From the [Atomic Energy] Commission's viewpoint, cost-plus-fixed-fee contracts possess other advantages. They bring into atomic energy operations persons from private employment who have technological abilities and talents not often found in the public service. They make available * * * the flexibility of private salary scales and promotional policies. And they keep open the possibility of a return to commercial activities for executives who do not want to remain in low-salary jobs in public employment (p. 64).

"As instruments of Government-business relationships, cost-plus-fixed-fee contracts give rise to controls unknown in any other context. They far transcend the controls usually associated with Government regulation and are quite dissimilar to the Government-business relationships which follow from traditional fixed-price and variable-price contracts * * * (p. 106).

"Additional support for the concept of the organizational unity of the Commission and its cost-plus-fixed-fee contractors is found in the integrated accounting system, the reporting system, and the use of liaison engineers, who are probably best regarded as the 'eyes and ears' of Commission officials. All these systems permit the review of cost-plus-fixed-fee contractors' activities, but go further in indicating tests and criteria for approval by public officials" (pp. 126–127).

In evaluating cost-plus-fixed-fee contracting the author points out that "when the unknowns in an entrepreneurial situation become very great, there is little social advantage in paying the profits that are expected to cover chance losses. The reason, we all know, is that the costs of procurement can be reduced if such losses are paid only as they are incurred (p. 158).

"Not only does the use of cost-plus-fixed-fee contracts create a predisposition in favor of large contractors, but it limits the possibilities of shifting from one contractor to another. * * * From this last standpoint, the problem of creating a competitive structure for future commercial applications in atomic energy is made more difficult rather than easier by an increase in private interest.

"Competitive industries simply are not created in the environment which gives rise to the use of cost-plus-fixed-fee contracts for defense. Public policies such as are followed by the Atomic Energy Commission, keeping in the public sphere all technological knowledge acquired at public expense and reducible to writing, are minimal. They must be supplemented by information and training programs to create competitive technical abilities in the ranks of rival industrial organizations. * * * Secrecy accentuates the concentration by introducing a waiting period before outsiders can even begin to think about the complex technological problems of atomic energy" (p. 171).

U.S. Atomic Energy Commission. The future role of the Atomic Energy Commission laboratories. [Report prepared for] Joint Committee on Atomic Energy, October 1960. Washington, U.S. Government Printing Office, 1960. 277 pp.

The Commission concludes that "The opportunities for mutual enrichment of the research and training activities of the laboratories and the universities will continue to be more fully utilized during the decade. All of the factors linking the laboratories and the universities—organization, personnel, related research projects, common use of Commission-owned facilities—will be encouraged and strengthened * * *. Progress has been made in recent years in arrangements for the utilization of these facilities by universities, both in the conduct of research programs and in affording opportunities to graduate students to do advanced work at the laboratories. Such arrangements have required modification of the normal practices of both the laboratories and

the universities * * *. By appropriate arrangements the laboratories can add strength to those universities which are not fully prepared to meet the demands for advanced training in specific fields * * *". (pp. 33–34).

Future plans for each laboratory of the AEC are then outlined on pages 34–103.

U.S. Commission on the Organization of the Executive Branch of the Government (1953–55). Research and development in the Government. May 1955 [Washington, U.S. Government Printing Office, 1955]. 50 pp.

The Commission accepted the administrative management recommendations of its task force and offered four additional recommendations. Among the administrative recommendations it suggested, "That the Weapons Systems Evaluation Group be shifted to contract operation with university or nonprofit organizations * * *". It also accepted the view of the task force that operations performed by Federal civilian agencies are "generally at a lower level of effectiveness than could be realized if suitably placed in the civilian economy." It recommended that "where choice is possible, operations of research and development should be performed at that place in the Nation where they can be done most effectively and with the greatest efficiency." In this connection it suggested that, "Even where operations must be done in military installations, frequently increased effectiveness and efficiency will be realized through operations by civilian economy organizations," and commended the trend in this direction by the Department of the Air Force.

U.S. Commission on Organization of the Executive Branch of the Government (1953–55) Committee on Business Organization of the Department of Defense. Subcommittee report on research activities in the Department of Defense and defense related agencies. April 1955 [Washington, U.S. Government Printing Office, 1955]. 91 pp.

"An appraisal and evaluation of the research and development activities in the Department of Defense, in defense related agencies, and other selected civilian Government agencies engaged in research projects affecting the Nation's military strength in an effort to determine the degree of overlapping and cost of such research and development * * *.

"The study is limited to an analysis of the various organizational patterns for the establishment, control, and administration of these programs, the mechanisms for cooperation and mutual support among the organizations involved in the programs, the many aspects of the complex professional personnel problem for both the military and the civilian, the various methods of tying and bonding to the civilian science and technical community, and the relationships with the military field forces."

U.S. Congress. House. Committee on Appropriations. Department of Defense appropriations for 1962. Hearings, 87th Cong., 1st sess., Pt. 4: Research, development, test, and evaluation. Washington, U.S. Government Printing Office, 1961. 548 pp.

In regard to grants to and research contracts with colleges, Dr. York states, "I feel that if the DOD would not actively support basic research at our colleges and universities there is a danger of a complete vacuum in many of the fields in which we are vitally interested because of the expense involved * * *" (p. 58).

In regard to contracts with nonprofit corporations, with especial reference to Aerospace Corp., Dr. York has this to say: "My comment is with the present rules and regulations, you could not set up an organization like the Aerospace Corp. within the Government in the time available to set it up. We needed it right away. It would be infeasible to have done it within the Government."

Mr. Mahon had previously stated that the "Committee on Appropriations is concerned over the lack of control over nonprofit organizations that do research jobs for the military" (p. 64).

See also Senate Committee on Appropriations hearings on Department of Defense Appropriations for 1962 [H.R. 7851] (pp. 1378–1379) for Mr. Gilpatric's defense of Aerospace Corp. salaries.

U.S. Congress. House. Committee on Appropriations. Department of Defense appropriation bill, 1962. Report. Washington, U.S. Government Printing Office, 1961. 73 pp. (87th Cong., 1st sess. H. Rept. 574).

"In the judgment of the committee, the Government is moving toward a chaotic condition in its personnel management because of [the practice of contracting with various corporations and organizations for technical management, scientific evaluations, etc.] * * *. The committee believes the procedures now followed are creating considerable additional costs for the taxpayers.

"To a considerable extent the use of contracts with nonprofit organizations is merely a subterfuge to avoid the restrictions of civil service salary scales.

"It is noted that the buildup of these organizations has not been accompanied by corresponding reductions in the number of military and civilian personnel on the Government rolls. * * * Military and civilian personnel on the payroll should be competent to do the jobs assigned to them or they should be removed from the payroll."

In recommending a reduction of $5 million in the budget request for Aerospace Corp. the committee states that it "feels that the salaries paid by the Aerospace Corp. are excessive, that its overhead costs are too high, and that it plans to employ too large a staff" (pp. 53–54).

U.S. Congress. House. Committee on Appropriations. Air Force intercontinental ballistic missile base construction program. Hearings, 87th Cong., 1 st sess. Washington, U.S. Government Printing Office, 1961. 310 pp.

Contractors and responsible Government officials present their views on various problem areas in the ballistic missile construction program Findings and recommendations of the committee are contained in House Report No. 51, 87th Congress, 1st session, dated March 3, 1961.

U.S. Congress. House. Committee on Armed Services. Contracting-out procedures. Hearings, 87th Cong., 1st sess., Aug. 8–16, 1961. Washington, U.S. Government Printing Office, 1961. 427 pp.

Testimony covers a wide variety of contractual services, but devotes considerable attention to what is termed "think" or "effort" contracts. The problem of cost comparisons between inhouse and contractual services are enumerated by Assistant Secretary of the Air Force (Materiel) Imirie (pp. 233–234).

Views of the American Federation of Government Employees are submitted in a statement concerning adverse effects of contracting Government work to private business (pp. 347–351).

U.S. Congress. House. Committee on Armed Services. Employment of retired military and civilian personnel by defense industries, Hearings, 86th Cong., 1st sess., July 7–Sept. 1, 1959. Washington, U.S. Printing Office, 1959. 1061 pp.

Witnesses include officials of the military services, contractors, and military and industrial associations. A detailed statement by the National Association of Manufacturers covers such matters as advertising, contributions and donations, compensation for personal services (pp. 299–334).

U.S. Congress. House. Committee on Armed Services. [Employment of retired military and civilian personnel by defense industries.] Hearings released from executive session relating to entertainment furnished by the Martin Co. of Baltimore, Md., of U.S. Government officers, 86th Cong., 1st sess., Sept. 10, 1959. Washington, U.S. Government Printing Office, 1959. 204 pp.

U.S. Congress. House. Committee on Armed Services. Employment of retired commissioned officers by Defense Department contractors. Report of the Subcommittee for Special Investigations, 86th Cong., 1st sess., Washington, U.S. Government Printing Office, 1960. 170 pp. (86th Cong., 1st sess., committee print.)

Data presented in this report is based on committee hearings and responses to a questionnaire sent to industry. The committee notes that "The 'coincidence' of contracts and personal contacts with firms represented by retired officers and retired civilian officials sometimes raise serious doubts as to the complete objectivity of some of these decisions" (p. 11). Referring to contractor practices of advertising of competitive weapons, the committee expresses its opinion "that such advertising is detrimental to the defense effort. It provokes controversy and promotes dissention, and introduces biased, narrow, and prejudicial considerations in purely military decisions" (p. 15). Appendixes include a compilation of laws and regulations relating to conflicts of interest in the military department, Department of Defense directives relating to conduct of procurement personnel, and statistical data on salaries and employment of retired officers by defense contractors.

The subcommittee report is incorporated in the committee report on H.R. 10959, dated March 21, 1961 (86th Cong., 2d sess. H. Rept. 1408).

U.S. Congress. House. Committee on Armed Services. Full committee consideration of H.R. 9682 and H.R. 10959, relating to the employment of retired commissioned officers by contractors of the Department of Defense and the Armed Forces [Washington, U.S. Government Printing Office, 1960], p. 3491–3616 (86th Cong., 2d sess. [committee document], No. 44).

Proposed legislation provides for forfeiture of retirement pay by retired officers accepting employment involving selling to the Department of Defense or a military department within 2 years after retirement. Legislation would also provide for registration of retired officers who accepted such positions and reporting by contractors of all retired personnel in their employment. The proposal (H.R. 10959) was reported favorably (H. Rept. No. 1408) and passed with an amendment on April 8, 1960.

For Senate Committee on Armed Services hearings see "Conflict of Interest of Retired Officers"; hearings, 86th Congress, 2d session, on H.R. 10959. No further action was taken by the Senate.

U.S. Congress. House. Committee on Armed Services. Hearings pursuant to section 4, Public law 86–89, Special Subcommittee on Procurement Practices of the Department of Defense, 86th Cong., 2d sess., Washington, U.S. Government Printing office, 1960. 752 pp.

Testimony deals with procurement policies, organization, and practices of the Department of Defense and the three military services with particular reference to their effectiveness in achieving reasonable costs, prices, and profits.

The views of the committee growing out of these hearings appear in House Report No. 1959, 86th Congress, 2d session. The committee notes that, "The fundamental weakness in the regulations and instructions of the service departments is the emphasis upon the authority to negotiate rather than on the requirement [of] a justification for negotiations" (p. 16). It suggests "wider use of the firm-fixed-price contract and competition both as to source and price * * *" (pp. 36–38).

U.S. Congress. House. Committee on Armed Services. Overpricing of Government contracts. Hearings before the Subcommittee for Special Investigations, 87th Cong., 1st sess. Apr. 27–28, 1961. Washington, U.S. Government Printing Office, 1961. 64 pp.

Comptroller General presents up-to-date information on recoveries relating to overpriced Air Force and Navy contracts previously discussed at the

July 1959 hearings on weapons systems management (UC263.A25 1959a). Witnesses from the Air Force and the Navy present statements on their respective efforts to improve contract negotiations.

U.S. Congress. House. Committee on Armed Services. Weapons system management and team system concept in Government contracting. Hearings before the Subcommittee for Special Investigations, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1959. 775 pp.

Witnesses include representatives of Boeing Airplane Co., North American Aviation, Inc., Martin Co., Lockheed Aircraft Corp., Convair Division of General Dynamics Corp., as well as Government representatives. Testimony deals with the nature of weapons systems management, its operation, pricing practices, and contractual arrangements.

U.S. Congress. House. Committee on Government Operations. Air Force ballistic missile management (formation of Aerospace Corp.), Report, May 1, 1961. Washington, U.S. Government Printing Office, 1961. 57 pp. (87th Cong., 1st sess. H. Rept. 324).

A review of ballistic missile management in the Air Force and a detailed account of efforts to meet criticisms of the missile management role of Space Technology Laboratories and Thompson-Ramo-Wooldridge. Describes the circumstances under which Aerospace Corp. was organized, its management structure, mission, and its relations to STL. Discusses such matters as salary scales (pp. 29–33), conflict-of-interest (pp. 33–35), facilities acquisition and future facilities plans (pp. 35–38), fees for contract work and contract patent rights (pp. 41–43).

Industry regards such management systems agencies as "meddlers in the weapon-building process and as piratic employers of scarce or highly prized scientific personnel. And more important, industry looks askance at the 'arsenal' potential of these agencies for 'sole source' fabrication of advanced weapon and space machinery * * *". Government critics view such agencies as taking on functions which should be performed by Government itself. Representative Martha W. Griffiths raises questions as to "whether the Government or the contractor will take title to facilities bought or built for use on a Government contract, where the Government is the sole, or almost the sole purchaser of items in or by such a facility."

U.S. Congress. House. Committee on Government Operations. Availability of information from Federal departments and agencies (Air Force refusal to the General Accounting Office). Washington, U.S. Government Printing Office, 1959. 121 pp. (86th Cong., 1st sess. H. Rept. 234).

Concerned with the refusal of the Air Force to make available to the General Accounting Office its "Survey of Management of the Ballistic Missile Program." In section III, beginning on page 21, testimony of General Rogers, Air Force Inspector General, is quoted. He explains that the objective of the inspection system is to provide the Air Force with a management tool to help assure maximum effectiveness * * *. He explains further that "the ballistic missile management survey was intended to be a top management inspection * * * to analyze and evaluate the management concept of the Air Force ballistic missile program * * *."

The Comptroller General enumerates the reasons why the "statement of facts" made available from the survey by the Air Force was unsatisfactory, pages 27–34. For instance, "the statement points out that due to manpower ceiling freezes BMD had an urgent requirement for secretarial services filled by Ramo-Wooldridge personnel. The statement further points out that no follow-on action was taken to replace Ramo-Wooldridge positions with civil service employees * * *."

U.S. Congress. House. Committee on Government Operations. Health research and training; the administration of grants and

awards by the National Institutes of Health, report. Washington, U.S. Government Printing Office, 1961. 110 pp. (87th Cong., 1st sess. H. Rept. 321).

Provides a broad view of organizational structure, program, policies and procedures for administering medical research and training grants. Recommendations include improvement in the present project review system, a cost-sharing basis for research grants initiated by commercial firms, the development of a uniform salary policy applicable to all agencies making grants to educational and other research institutions, better coordination of research activities with other Government and private agencies, initiation for a limited time of special developmental-type grants to stimulate research, optional use of either of two methods for computing overhead allowance on supported research, and reexamination of the policy of making indirect cost payments on renovation and major equipment expenditures from grants for the establishment of clinical research facilities (pp. 73–75).

U.S. Congress. House. Committee on Government Operations. Organization and management of missile programs. Hearings before a subcommittee, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1959. 803 pp.

Testimony deals with organizational arrangements in the Department of Defense for the direction and cordination of the missile programs of the three military services; describes organizations and procedures devised to streamline operations; examines procurement and management agencies, and related aspects of the missile program. Devotes considerable attention to the corporate background and operations of Ramo-Wooldridge Corp. and its successor, Space Technology Laboratories, Inc. Includes text of the Gillette report: "Air Force Plan for Simplifying Administrative Procedures on Missile Programs," pages 639–653.

Finding and conclusions are reported in the committee's 11th report (H. Rept. 1121, 86th Cong., 1st sess.). In summary the committee notes that, "Neither the timing, nor the technology, nor the threefold separation of the services is conducive to decisions that given weapons systems can be withdrawn or abandoned in the interest of economy or efficiency."

U.S. Congress. House. Committee on Government Operations. Organization and management of missile programs. Hearings before a subcommittee, 86th Cong., 2d sess. May 3–6, 1960. Washington, U.S. Government Printing Office, 1960. 228 pp.

Testimony deals with reorganization of space and missile functions, transfer of space projects to NASA, assignment of military space functions, current status of ARPA, new missile and space projects, NATO and British missile developments. Includes text of Millikan Committee report, pages 86–91.

U.S. Congress. House. Committee on Government Operations. Research and development. Hearings before a subcommittee, 85th Cong., 2d sess. Washington, U.S. Government Printing Office, 1958. 481 pp.

Testimony deals with organizational structure and procedures as they relate to advancing scientific research. Of particular interest are the views of Dr. Alan T. Waterman and Dr. C. C. Furnas on the relative efficiency and economy in the conduct of R. & D. through Government facilities, universities, other nonprofit organizations, and private contractors (pp. 49–62, 170–173). Dr. Rowland Egger's paper on problems of governmental organization in scientific research (pp. 463–467) suggests that the entire area of Government contracts for research needs to be restudied. "While the evidence is not entirely clear, it does seem to be true that contracting methods and specifications appropriate to the administration of traditional functions of the Government have been carried over by brute force and sheer awkwardness into the area of scientific research contracting, in which they protect adequately the interests neither of the Government nor the contractor."

U.S. Congress. House. Committee on Government Operations. Research and development (Office of the Secretary of Defense). Report. Washington, U.S. Government Printing Office, 1958. 218 pp. (85th Cong., 2d sess. H. Rept. 2552).

A basic background study on the organizational structure for research and development in the Office of the Secretary of Defense, the financing of R. & D. programs, planning for the future, duplication and interservice rivalry, and the need for improved management and control. The impact of retrenchment policies on industrial and academic contractors performing research and development for the Government is reviewed briefly on pages 35–41.

U.S. Congress. House. Committee on Interior and Insular Affairs. Policies, programs, and activities of the Department of the Interior. Hearings, 87th Cong., 1st sess., Jan. 16–Feb. 28, 1961. Washington, U.S. Government Printing Office, 1961. 292 pp.

Dr. A. L. Miller, Director of Office of Saline Water, testifies on the nature of research conducted by the Office (pp. 244–253), procedures for negotiating research and development contracts (pp. 281–282), and problems of patent rights (pp. 285–292).

U.S. Congress. House. Committee on Post Office and Civil Service. Manpower utilization in the Federal Government. Hearings, 85th Cong., 2d sess., Dec. 1–5, 1958. Washington, U.S. Government Printing Office, 1959. 401 pp.

Testimony submitted by officials of the Department of Defense, the three military service departments, Agriculture, Commerce, Health, Education, and Welfare Departments, National Aeronautics and Space Administration, Civil Service Commission, and the Bureau of the Budget. In introducing Assistant Director Staats of the Bureau of the Budget the chairman states, "We hope * * * that during your testimony * * * you may be able to tell this subcommittee that action, vigorous action, is being taken and going to be taken to provide standards to guide our Government officials toward more effective manpower utilization, and especially contracting practices involving delegation of personal and official responsibility."

U.S. Congress. House. Committee on Post Office and Civil Service. Manpower utilization in the Federal Government. Hearings, 87th Cong., 1st sess., Apr. 11–12, June 5, 12, 1961. Washington, U.S. Government Printing Office, 1961. 138 pp.

Salary levels at Aerospace Corp. are the subject of many questions in connection with Under Secretary of the Air Force Charyk's testimony, pages 121–138. Questions were also raised by Representative Gross concerning a $1,500,000 fee to Aerospace Corp., page 133.

U. S. Congress. House. Committee on Post Office and Civil Service. Personnel procurement costs of selected defense contractors for recruitment of engineers and scientists, fiscal year 1959. Washington, U.S. Government Printing Office, 1960. 9 pp. (86th Cong., 2d sess., committee print).

Significant aspects of the data are: (1) In general the contractors with predominant Government business spent more to recruit engineers and scientists than did those firms working predominantly on commercial business; (2) separation rates of engineers and scientists from the sample of 102 firms was pretty much in line with current separation rates, both in private industry and in the Federal Government; (3) annual recruiting by firms with Government business was higher than recruiting by predominantly commercial firms; (4) of four firms spending in excess of $2,000 per individual newly hired, three were Government contractors.

U.S. Congress. House. Committee on Post Office and Civil Service. Preliminary report on the aspects of the missile program in the

Departments of the Navy and the Air Force. Subcommittee on Manpower Utilization, 86th Cong., 1st sess., April 1959. Washington, U.S. Government Printing Office, 1959. 47 pp. (committee print).

The committee concludes that: (1) Procurement policies have permitted considerable contracting out of technical, project, and management responsibilities; (2) scientific and engineering manpower in the missile program is not being fully utilized and accomplishments to date could have been achieved "with less manpower under a more coordinated and practical policy;" (3) Government is competing with itself and with defense contractors for qualified employees.

In a letter requesting a survey by the General Accounting Office the chairman asks for the following information: "What standards have been and/or should be established by the Federal Government to determine the reasonableness and uniformity of fees in cost-plus contracts? Why was Ramo-Wooldridge placed in such an indispensable position in Air Force's long-range ballistic missile operation? What have been the financial relationships bebetween Ramo-Wooldridge, Thompson Products, Inc., and the Space Technology Laboratories? What personal gains have been made by key employees and former Government employees * * *" and other data pertinent to a full examination of the program.

U.S. Congress. House. Committee on Post Office and Civil Service. Survey of certain aspects of the ballistic missile program of the Department of the Air Force, as developed by the Subcommittee on Manpower Utilization, and by the Comptroller General of the United States. December 30, 1960. Washington, U.S. Government Printing Office, 1960. 60 pp.

U.S. Congress. House. Committee on Science and Astronautics. Basic research in agriculture. Hearing, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1959. 74 pp.

Reprints text of Comptroller General reports of October 21, 1959, and May 19, 1960, on various aspects of the ballistic missile program together with letters from the chairman of the subcommittee to the Secretary of Defense dated June 7 and July 15, 1960, and a letter from the Secretary of the Air Force dated August 18, 1960, commenting on the Comptroller General's reports.

U.S. Congress. House. Committee on Science and Astronautics. Basic research in agriculture. Hearing, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1959. 74 pp.

Testimony of officials of the Agricultural Research Service deals with types of research being undertaken, the character of the organization and the methods employed. Includes a list of contracts and contractors for fiscal year 1958 (pp. 39–42) and a set of organization charts (pp. 55–63).

U.S. Congress. House. Committee on Science and Astronautics. Basic scientific and astronautic research in the Department of Defense. Hearings, 86th Cong., 1st sess. June 4–30, 1959. Washington, U.S. Government Printing Office, 1959. 536 pp.

Testimony covers programs, personnel, funding and management of research and development in the Department of Defense and the three military services. Findings are summarized in House Report No. 1182, 86th Congress, 1st session.

U.S. Congress. House. Committee on Science and Astronautics. Defense space interests. Hearings, 87th Cong., 1st sess. March 17–23, 1961. Washington, U.S. Government Printing Office, 1961. 220 pp.

Testimony deals with the implications of the Department of Defense directive of March 6, 1961, dealing with "Development of Space Systems."

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Views of witnesses are summarized in House Report No. 360, 87th Congress, 1st session, "Military Astronautics (Preliminary Report)," May 4, 1961.

The committee concludes that:

"(*a*) The Air Force is fully responsive to the needs of the other two services.

"(*b*) Army and Navy ideas useful to advancing the national program for space development are not ignored.

"(*c*) Army, Navy and Air Force personnel and facilities * * * are fully used in the interest of efficiency, economy, and the morale of the fine teams which serve them.

"(*d*) There is continuing close cooperation with NASA, so that both the Department of Defense and the civilian agency can find full expression without waste in their respective spheres."

U.S. Congress. House. Committee on Science and Astronautics. Management and operation of the Atlantic Missile Range. Report [prepared by Spencer M. Beresford], 86th Cong., 2d sess., July 5, 1960. Washington, U.S. Government Printing Office, 1960. 11 pp. (86th Cong., committee print).

Commenting on Pan Am as contract manager, the committee concludes that past shortcomings have been largely corrected or are in the process of correction and that the contract is "probably as satisfactory today as any alternative." Points out that this is not to imply that, "Pan Am or any other private corporation should have been given the job * * * in the first instance."

U.S. Congress. House. Committee on Science and Astronautics. Missile development and space sciences. Hearings, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1959. 492 pp.

The first public activity of the newly constituted Committee on Science and Astronautics. The purpose of the hearings was to present a picture of the situation in the fields of science and astronautics. Reviews the entire missile and space program. Testimony of witnesses is summarized in House Report 562, 86th Congress, 1st session, entitled, "Status of Missile and Space Programs."

U.S. Congress. House. Committee on Science and Astronautics. The National Bureau of Standards and the space program. Hearings, 87th Cong., 1st sess., May 11–12, 1961. Washington, U.S. Government Printing Office, 1961. 68 pp.

Dr. A. V. Astin and other Bureau representatives testify on the mission of the National Bureau of Standards and some of the problems confronting it. Inadequate facilities and funding are indicated as major obstacles and the need of the Bureau "to be placed in a better position with respect to recruiting and retention of senior scientists." Testimony is summarized in House Report No. 711, 87th Congress, 1st session, dated July 12, 1961.

U.S. Congress. House. Committee on Science and Astronautics. Patent policies relating to aeronautical and space research. Hearings before the Special Subcommittee on Patents and Scientific Inventions, 87th Cong., 1st sess., on H.R. 1934 and H.R. 6030. Washington, U.S. Government Printing Office, 1961. 400 pp. ([Document] No. 20).

The purpose of the hearing is "to learn not only what patent practices industry follows in conducting space research and development, but why it follows them and what the practical effects are. We will try to learn how much concentration of space contracting may result from the Government's space patent policy, what rights the Government demands of industry and what concomitant rights industry seeks from its subcontractors and employees * * *." Text of the Archie Palmer study, "Administration and Utilization of Government-Owned Patent Property," dated December 23, 1960, is included in the hearings, pp. 65–138.

U.S. Congress. House. Committee on Science and Astronautics. Property rights in inventions made under Federal space research contracts. Hearings before the Subcommittee on Patents and Scientific Inventions, 86th Cong., 1st sess., on Public Law 85–568. Washington, U.S. Government Printing Office, 1959. 981 pp. ([Document] No. 47).

Testimony of witnesses representing Government, industry, the bar and the academic world favors changes in existing provisions of section 305 of the National Aeronautics and Space Act of 1958. "The preponderance of testimony * * * favored deletion of the present section 305 and substitution, in lieu thereof, of a provision by which the Government would receive a nonexclusive, royalty-free, nontransferable, nonrevocable license for governmental use. Summary of testimony and recommendations of the subcommittee are contained in "Proposed Revisions to the Patent Section, National Aeronautics and Space Act of 1958 Report," dated March 8, 1960 (TL521.A53 1960b). Subcommittee recommendations were incorporated into H.R. 12049, amending the National Aeronautics and Space Act of 1958, which passed the House on June 9, 1960. The Senate took no action on the measure and it died with the 86th Congress.

U.S. Congress. House. Committee on Science and Astronautics. Research and development for defense. Hearings, 87th Cong., 1st sess. Washington, U.S. Government Printing Office, 1961. 178 pp.

A general review of the status of scientific and astronautical research and development in the defense agencies. Committee questions center around progress to date, possible areas of duplication, and levels of cost.

U.S. Congress. Senate. Committee on Aeronautical and Space Sciences. Investigation of governmental organization for space activities. Hearings, 86th Cong., 1st sess., Mar. 24–May 7, 1959. Washington, U.S. Government Printing Office, 1959. 762 pp.

Officials of the Department of Defense, the three military services, and the National Aeronautics and Space Administration present testimony on the organization and conduct of their respective programs. For specifics consult index, pages 749–762. Summary of testimony and committee findings are presented in Senate Report 806, 86th Congress, 1st session, entitled, "Governmental Organization for Space Activities."

U.S. Congress. Senate. Committee on Appropriations. Federal support of medical research; report of the Committee on Consultants on Medical Research to the Subcommittee on Departments of Labor and Health, Education and Welfare, 86th Cong., 2d sess., May 1960. Washington, U.S. Government Printing Office, 1960. 133 pp.

Conclusions and recommendations of the committee are on page 107. They deal with adequacy of Federal support of medical research; effectiveness of utilization of Federal funds appropriated for medical research; impact of the expanding Federal program in support of medical research; and status of medical manpower.

U.S. Congress. Senate. Committee on Armed Services. Military procurement. Hearings before a subcommittee, 86th Cong., 1st sess., on S. 500 [etc.] Washington, U.S. Government Printing Office, 1959. 671 pp.

Representatives of Government and industry submit views on proposed legislation to increase flexibility in military procurement. Weapon-systems management and procurement policy is discussed throughout the hearing. See particularly appendixes (pp. 495–671) for special analyses and studies.

U.S. Congress. Senate. Committee on Armed Services. Procurement study. Hearings before the Procurement Subcommittee, 86th Cong., 2d sess. Washington, U.S. Government Printing Office, 1960. 273 pp.

John J. Phelan, Assistant Director for Procurement Policy, discusses research and development contract practices of the Department of Defense, pages 93–97; G. C. Bannerman, Director of Procurement Policy, testifies on the weapon systems concept, how it is used, and why it is needed, pages 99–105; Comptroller General presents his views, pages 146–147. Findings and recommendations growing out of the hearings are reported in Senate Report No. 1900, 86th Congress, 2d session.

U.S. Congress. Senate. Committee on Government Operations. Federal budgeting for research and development. Hearings before the Subcommittee on Reorganization and International Organization, 87th Cong., 1st sess. Agency coordination study, July 26–27, 1961. Washington, U.S. Government Printing Office, 1961–62. 2 pts.

The principal problem under review in these hearings is: "How can the Federal budget be improved with respect to control of research and development expenditures."

Part I, the hearing volume, deals with long-range planning, programing and budgeting in the Department of Defense (pp. 7–150) and in the National Aeronautics and Space Administration (pp. 154–205). Dr. Harold Brown, Director of Defense Research and Engineering, OSD, testifies on progress in long-range planning in the Department of Defense (pp. 7–49). The importance of in-house research is mentioned briefly (p. 15) and discussed more fully in an address and memorandum included as exhibit 29 (pp. 222–226). Other exhibits include a statement and charts of organization for research and development (pp. 59–64), a statement defining and describing research activities (p. 74), and submissions dealing with payment of costs for independent research and development work (pp. 92–100). Mr. James E. Webb, Administrator, National Aeronautics and Space Administration, testifies on relationships with other agencies, planning and programing, and NASA contributions to basic research. Mr. Webb notes that, "80 to 85 percent of all our dollars go out under contract either with industry or universities, most of it with industry, for technology. We nevertheless, have to manage support for basic research. And in order to this well, we have in each of our centers, a certain fund, not large, but enough to keep the people there in funds to do basic research in order to keep them right up to date and abreast of the program as a leader in the field" (p. 193).

Part II provides background data on the total Federal commitment for research and development. It includes correspondence with the Bureau of the Budget on Government-wide policies affecting this phase of budgeting (pp. 243–251), information from the National Science Foundation on its central role in budgeting for basic reseach (pp. 253–270), detailed reports from the Department of Commerce on problems of budgeting for research and development (pp. 272–341), and expositions from other selected agencies.

U.S. Congress. Senate. Committee on Government Operations. Organizing for national security. Science, technology, and the policy process. Hearings before the Subcommittee on National Policy Machinery, 86th Cong., 2d sess., Apr. 25–27, 1960. Washington, U.S. Government Printing Office, 1960, pp. 237–411.

Dr. James A. Perkins, vice president of the Carnegie Corp., comments on the role of the scientists, pointing out that "he is in danger of being both underused and overused. He will be underused when he is placed in a Government laboratory and given detailed instructions and blinders and told to 'solve the specific problem, please.' Experience has long since demonstrated the value of an arm's length arrangement that makes it possible for a scientist to bring to bear his creative imagination on a widely and loosely defined problem. Scientific laboratories under military direc-

tion have frequently not prospered. * * * On the whole, the more creative the approach required, the more substantial the case for putting the scientist in a unversity environment on a contract arrangement" (p. 242).

Dr. Edward M. Purcell, professor of physics, Harvard University, points out the need for the Government to enter into contracts with universities, nonprofit and profitmaking corporations for the use of key personnel for longer periods of time in order to promote research essential to the Government (pp. 389–390).

Dr. Herbert F. York, Director of Defense Research and Engineering, also presents his views on this matter as well as on the difficulties relating to conflict of interest laws (pp. 400–402).

Prof. Bayless Manning, Association of the Bar of the City of New York, indicates that contracting out does not solve the personnel question since Government must have in-house competence to review, screen, and appraise the technical aspects of contracting-out arrangements (pp. 460–461).

U.S. Congress. Senate. Committee on the Judiciary. Government patent policy. Hearings before the Subcommittee on Patents, Trademarks, and Copyrights, 87th Cong., 1st sess., on S. 1084 and S. 1176. Apr. 18–21, May 31–June 2, 1961. Washington. U.S. Government Printing Office, 1961. 2 pts.

In his opening statement Senator McClellan notes:

"We know that our Government is presently acting in the disposition of patent rights in these inventions as if it were several different governments with different objectives. For instance, we find the Defense Department making contracts with a patent clause that gives the contractor title to any resulting inventions while other Government agencies dealing with the same contractors for research in the same fields are using patent clauses that give the Government title to these inventions.

"Who gets the title frequently decides who gets the main benefits from the invention."

Senator Russell B. Long observes (p. 13) that "if you compare the contracts in the Atomic Energy Commission and other Government agencies with the contracts where the contractor keeps the patent rights, there is no convincing evidence that it costs any more.

"But if it did cost a little more, the fantastic values involved here and the tremendous cost to the consumer to buy back something that he has paid for already * * * to buy it back at a monopoly price, are so enormous that it would seem to me that we are failing to protect the public interest if for a small cash saving we make it possible for persons to have these enormous patent monopolies that we are creating with $9 billion a year of Government-financed research."

Testimony covers practices in the Department of Defense, the three military services, National Aeronautics and Space Administration, and the Federal Aviation Agency and gives views of representatives from trade associations and private industry.

U.S. Congress. Senate. Committee on the Judiciary. National patent policy. Hearings before the Subcommittee on Patents, Trademarks, and Copyrights, 87th Cong., 1st sess., on S. 1084 and S. 1176. Washington, U.S. Government Printing Office, 1961. 63 pp.

Admiral Rickover testifies on the present patent situation which he considers unsatisfactory. "Agencies of the same U.S. Government," he points out, "pursue diametrically opposed policies on patent rights to inventions financed by the Government even when it may concern the same area of technology, such as medical research where the Defense Department and the Department of Health, Education, and Welfare follow different policies. This naturally makes for inequities. It leaves the power of decision on an important public matter that should be regulated by Congress to contracting officers of different agencies * * *" (p. 4).

In response to Senator Wiley's observations that the Government had the right to take the patent and pae for it, Admiral Rickover asks, "but why pay again for something you have already paid for?"

U.S. Congress. Senate. Committee on the Judiciary. Patent practices of the Department of Defense, 87th Cong., 1st sess. Washington, U.S. Government Printing Office, 1961. 129 pp. (committee print).

In judging the present patent policy, the Department of Defense expresses the view that "in the areas of its responsibility its policy of generally acquiring for the Government a royalty-free license, instead of title, to an invention conceived or first actually reduced to practice under its research and development contracts, is in the best interest of the United States * * *.

"The Department of Defense does not recommend any legislation or change in policy with respect to patent rights in inventions resulting from research and development contracts. It is recommended that Executive Order 10096 be rescinded and superseded by the enactment of legislation which would enact into law the judicial standards which have been followed for the past century in determining Federal-employee invention rights" (pp. 39–40).

U.S. Congress. Senate. Select Committee on Small Business. Patent policies of departments and agencies of the Federal Government—1959. Hearings before a subcommittee, 86th Cong., 1st sess. Washington, U.S. Government Printing Office, 1960. 454 pp.

"There is no one Government patent policy. Various Federal agencies and departments have sharply varying policies with regard to taking title to patentable inventions made under research and development contracts with private organizations.

"The magnitude of this effort makes it apparent that the distribution and Federal policies in the handling of the resulting inventions of these contracts have a significant effect upon the organization of the American economy.

"First, there is the problem of increasing economic concentration brought about by the granting of patent rights to individual firms for discoveries which result from Government-financed research and development contracts.

"Second, there is the problem of assuring that newly acquired technological information developed at Government expense and not of a classified nature is diffused throughout our society. The American people foot the bill. Do they receive commensurate benefits from their work?

"The third problem is whether the U.S. Government is getting all that it pays for from its research and development dollar" (pp. 1–2).

The withdrawal of patent privileges from firms performing R. & D. for the Government at the latter's expense does not remove all competitive advantage accruing to such firms. Dr. Daniel Hambert, University of Maryland, points out that:

"Where there is fortuitously direct and immediate commercial applications, or where the contracting firms will take contracts, as they often do, only when the R. & D. is relevant to technical and hence commercial problems already confronting the firm, the result is in either case that although the firm may provide the Government with a sought-for 'product,' the firm in the process gets its R. & D. costs financed by the Government.

"A second important advantage is that [it] enables the firm to acquire scientific personnel that it ordinarily might be unable to do.

"This is certainly one of the paradoxes * * * of the present system * * * because, unquestionably, the contracting firms * * * bid up the prices, the wages, and salaries of scientific and technical personnel.

"In the process they compete away such personnel from the Government sector, from Government research and development laboratories. The Government is, thereby, deprived of its own highly qualified personnel, and in the end winds up paying more for R. & D. than it otherwise would * * *.

"Thirdly, we should note that the performing firm, ipso facto, acquires a considerable body of information relating to the invention, information that is unpatentable, but possession of which is often indispensable to the proper use of the invention. * * * The withdrawal of patent rights from performing firms would not and could not deprive them of this often priceless know-how.

"Whether by design, or chance, or more likely, administrative expediency, Government R. & D. contracts have been let primarily to the giant corpora-

tions * * * this practice automatically confers great competitive advantages on the giant firms vis-a-vis their smaller competitors, thereby promoting already extant monopolistic tendencies" (pp. 5–21).

U.S. Department of Health, Education, and Welfare. The advancement of medical research and education through the Department of Health, Education, and Welfare. Final report of the Secretary's Consultants on Medical Research and Education. Washington, U.S. Government Printing Office, 1958. 82 pp.

The consultants find that the most important problems of public policy arise in connection with Federal support of research in non-Federal laboratories and that this support inevitably raises questions bearing upon the relationships between Government and universities (p. 15).

They recommend that "A number of Federal agencies continue to finance a substantial medical research effort both to make their operations more effective, and to sustain a productive medical research program in non-Federal non-profit research institutions" (p. 27).

They also recommend that, "In the Federal Government's efforts to foster research and training in the fields of health and medicine the principle of payment of full costs be adopted" (p. 71).

U.S. Department of Justice. Government-sponsored industry research. (In its Report of the Attorney General pursuant to sec. 708(e) of the Defense Production Act of 1950, as amended. Nov. 9, 1956, pp. 2–53.)

An examination of the nature of the problem, the relative importance of Federal research expenditures, benefits to industry from performance of Government research, and the impact of federally financed research and development on competitive position of contractors.

Concludes that "The imprecise factual indicators discussed in this report may point a warning that the total effect of the research and development effort may well tend to increase concentration of economic power. Moreover, that evidence indicates that this tendency toward concentration may be accentuated, and not retarded, by the administration of Government financing of research and development * * *.

"Some action can be suggested to alleviate some of the features of present operations which seem to tend toward concentration. It is accordingly recommended that consideration be given to: first, the possibility of removing certain practical obstacles to the participation of smaller businesses in the research and development effort; and second * * * a reevaluation of the basic patent policy of the Department of Defense, in the light of current defense problems and the increased participation of Government in research activity, to determine whether Government acquisition of resulting inventions and patents would be more in the public interest."

Text of report reprinted in: U.S. Congress. House. Committee on Science and Astronautics. Property rights in inventions made under Federal space research contracts, hearings, 86th Cong., 1st sess., on Public Law 85–568. 1959, pp. 888–904.

U.S. General Accounting Office. Initial report on review of administrative management of the ballistic missile program of the Department of the Air Force. Washington, 1960. 124 pp.

"The ballistic missile program is the largest single military program undertaken by the United States involving the expenditure of about $2 billion a year. The need to accelerate this program and the lack of in-house capability within the Air Force prompted [the decision] in 1954 to contract with a private corporation for the systems engineering and technical direction of the program. However, although more than 5 years has elapsed, the Air Force has not developed an in-house capability to carry out the functions assigned to the contractor.

"By delegating the technical aspects of this management to a contractor, the Air Force has, to a significant degree, removed itself from the direct management of the program and, as a practical matter, has shifted a portion of its responsibility for the success of this crucial program to a contractor.

"We believe that a program of this importance should be conducted under the direct leadership and responsibility of the Government agency to which it is entrusted.

"* * * We believe that it would be advisable for the Air Force to develop in-house capability to provide systems engineering and technical direction for its ballistic missile program * * *."

U.S. General Accounting Office. Report on survey of certain aspects of the ballistic missile program of the Department of the Air Force. May 19, 1960. (In U.S. Congress. House. Committee on Post Office and Civil Service. Survey of certain aspects of the ballistic missile program of the Department of the Air Force, Dec. 30, 1960. Washington, U.S. Government Printing Office, 1960, pp. 8–50.)

Findings cover such matters as standards for determination of reasonableness of fees and for reimbursable costs, rates of fixed fee for R–W/STL and Applied Physics Laboratory, salary rates and personal gains made by key employees of R–W/STL. Stresses the need for developing in-house capability to provide systems engineering and technical direction for ballistic missile programs.

U.S. General Accounting Office. Report on survey of supplemental payments to contractor employees at Department of Defense test facilities. Oct. 21, 1959. (In U.S. Congress. House. Committee on Post Office and Civil Service. Survey of certain aspects of the ballistic missile program of the Department of the Air Force, Dec. 30, 1960. Washington, U.S. Government Printing Office, 1960, pp. 1–7.)

The review discloses that contractor employees receive travel allowances although located at Edwards Air Force Base for extensive periods; that a DOD study showed the need for control of supplemental payments made by defense contractors at DOD test facilities. The report concludes that "in many cases, supplemental pay is justified but the cost principles presently contained in the Armed Services Procurement Regulations are not adequate to achieve an improvement in the present situation; that greater uniformity is warranted * * * and that the practice, in many cases, resulted in unnecessary and unreasonable costs to the Government * * *."

U.S. Library of Congress. Legislative Reference Service. The U.S. guided missile program. Prepared for the Preparedness Investigating Subcommittee of the [Senate] Committee on Armed Services, by Charles H. Donnelly. Washington, U.S. Government Printing Office, 1959. 129 pp.

"This report is a study of U.S. policies and accomplishments in the development of its missile program. It is not intended to be historical, though enough background will be laid to put the program into perspective. It is intended to aid in arriving at a better understanding of the size and complexity of our program * * *."

Chapter V, "Organization and Control of U.S. Guided Missile Program," pages 38–59, considers Government agencies outside the Department of Defense as well as those in the Department. Among those within the Department of Defense are ARPA, Ballistic Missiles Committee, Scientific Advisory Committee, Weapons Systems Evaluation Group and the Army, Navy, and Air Force missile organizations.

U.S. National Science Foundation. Funds for research and development in industry, 1958: performance and financing. Washington, U.S. Government Printing Office, 1961. 119 pp. (NSF–61–32).

Federal funds for industrial R. & D. by industry and size of company for 1958, pages 5–8. Data for 1959 and 1960 are reported in Reviews of Data on Research and Development, No. 30, September 1961.

U.S. National Science Foundation. Scientific research and development of nonprofit organizations; expenditures and manpower, 1957. Washington, U.S. Government Printing Office, 1961. 58 pp. (NSF–61–37).

Data on expenditures for basic, applied and development research and manpower employed in Federal contract research centers are presented on pages 33–35. Data for 1958 are reported in Reviews of Data on Research and Development, No. 24, October 1960.

CONGRESSIONAL RECORD AND NEWSPAPER ARTICLES

Congressional Record, Aug. 5, 1957, v. 103, p. 13687. Review of atomic energy program, and latest authorization bill (H.R. 8996).

Representative Holifield is critical of the Atomic Energy Commission. Mentions that the contract negotiation program is carried on in three different ways: by privately financed projects; by Government-owned and sponsored reactors for experimental or demonstration purposes; and by privately sponsored projects with some research and development assistance.

Congressional Record, May 5, 1960, v. 106, pp. 9600–9613. Department of Defense appropriation bill, 1961.

Remarks of Representative Gross, critical of defense contracts, cites specific firms, such as Booz, Allen & Hamilton, Institute for Defense Analyses, Rand Corp. and others, on pages 9612–9613.

Congressional Record, June 2, 1960, v. 106, p. A4719. Competitive private enterprise in space, by Ralph J. Cordiner.

Text of Mr. Cordiner's address at the University of California at Los Angeles on May 4, 1960, in which he states: "In the case of atomic energy it has been possible to erect certain reasonable boundaries around the Government's research and development activities, while in the area of the so-called space sciences, this is totally impossible. It is the confusion of these two types of technologies which has led to the National Aeronautics and Space Administration patent clause, which is so unworkable and poses such a threat to the independence of private enterprise. An even more disturbing effect of the growth of Government-sponsored research and development is the temptation for the Federal Government to build its own facilities and personnel in the technical fields, or to establish so-called nonprofit organizations which are totally dependent on Government contracts. However generous their motives, these nonprofit organizations are usurping a field traditionally served by private consulting firms and producer companies, and hence are little more than a blind for nationalized industry competing directly with private enterprise—on a subsidized, nontaxpaying basis."

Congressional Record, June 28, 1961, v. 107 (temporary file), pp. 10672–10698. Department of Defense appropriation bill, 1962.

Representatives McCormack, Holifield, Gross, Mahon, Kilday debate the complexities of modern weapons systems and current Defense Department trends in the use of nonprofit organizations. Aerospace Corp., Space Technology Laboratories, Inc., Ramo-Wooldridge Corp. are discussed. Mr. Mahon states that "we are moving toward a state of chaos and irresponsibility in this field, and somebody with a firm hand is going to have to watch the situation very carefully" (p. 10676). Representative Gross is critical of the salaries of the executives of Aerospace (p. 10682).

Congressional Record, Aug. 8, 1961, v. 107 (temporary file), pp. 13979–13980. Refund of $559,000 by Thompson-Ramo-Wooldridge.

Senator Case brings up the matter of a refund by Thompson-Ramo-Wooldridge, Inc., a contractor, with respect to the pricing of some screws. He inserts in the Record a letter from Secretary of the Air Force Zuckert, an Associated Press dispatch, a Department of Defense statement for the Bureau of the Budget, and a review of the matter by the General Accounting Office.

New York Times, May 22, 1960, sec. 3, p. 1. Rand Corp. furnishes brain power for the Air Force, by Bill Becker.

A description of the organization and functions of the Rand Corp.

New York Times, June 26, 1960, p. 1+. Air Force forms new missile unit, by Gladwin Hill.

Describes the establishment of the Aerospace Corp. and its responsibilities.

New York Times, Nov. 8, 1961, p. 37+. AEC liberalizes university fees, by John W. Finney.

New policy is adopted which will let institutions make profit on management of atom laboratories. Contracts will follow pattern of cost-plus-fixed-fee utilized for industry.

New York Times, Nov. 19, 1961, p. 1+. Scientists face income inquiry, by John W. Finney.

A subcommittee of the House Armed Services Committee will check the charge that some are profiting from Federal research.

New York Times, Dec. 4, 1961, p. 1+. White House acts to keep top scientists in U.S. jobs, by John W. Finney.

Widespread exodus and a decline in quality predicted. Low pay held a major factor in resignations.

Wall Street Journal, Feb. 19, 1960, p. 1+. Guilding the ivy—MIT points up rush of schools into Federal and business research, by Paul Lancaster.

Discusses the magnitude, problems, and implications of Federal support of research at the universities and colleges.

Wall Street Journal, Dec. 4, 1961, p. 1+. Missile managers. Aerospace Corp. stirs criticism of Pentagon's use of nonprofit firms, by Richard F. Roper.

Some industrialists complain of the competitive threat and criticize salary and benefit policies of these companies. Tighter controls may be ahead.

Wall Street Journal, Dec. 6, 1961, p. 1+. Cash for colleges—educators say grants from United States often warp academic program, by Edmund K. Faltermayer.

Charges that there is undue emphasis on sciences and graduate work.

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